Cement MILL EDITION of Concrete

Devoted to the Manufacture,
and Use, of Portland Cement

AUGUST, 1935

400 West Madison Street
Chicago, Illinois

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Stop Worrying About Washington

REPRESENTATIVES of eighteen building material trade associations held a conference in Washington on July 3 with Harry L. Hopkins, works relief administrator.

◖ Mr. Hopkins was asked about the figure of $1,140 per man per year, reported to have been established as the maximum amount to be spent on any construction project. This was the supposed ruling that raised a howl of protest all over the country some eight or ten weeks ago.

◖ Mr. Hopkins replied that it was most unfortunate that this figure ever was given publicity, for it merely represented a rough average. In many cases, he said, the figure per man would run ***as high as $3,000, particularly in road construction.***

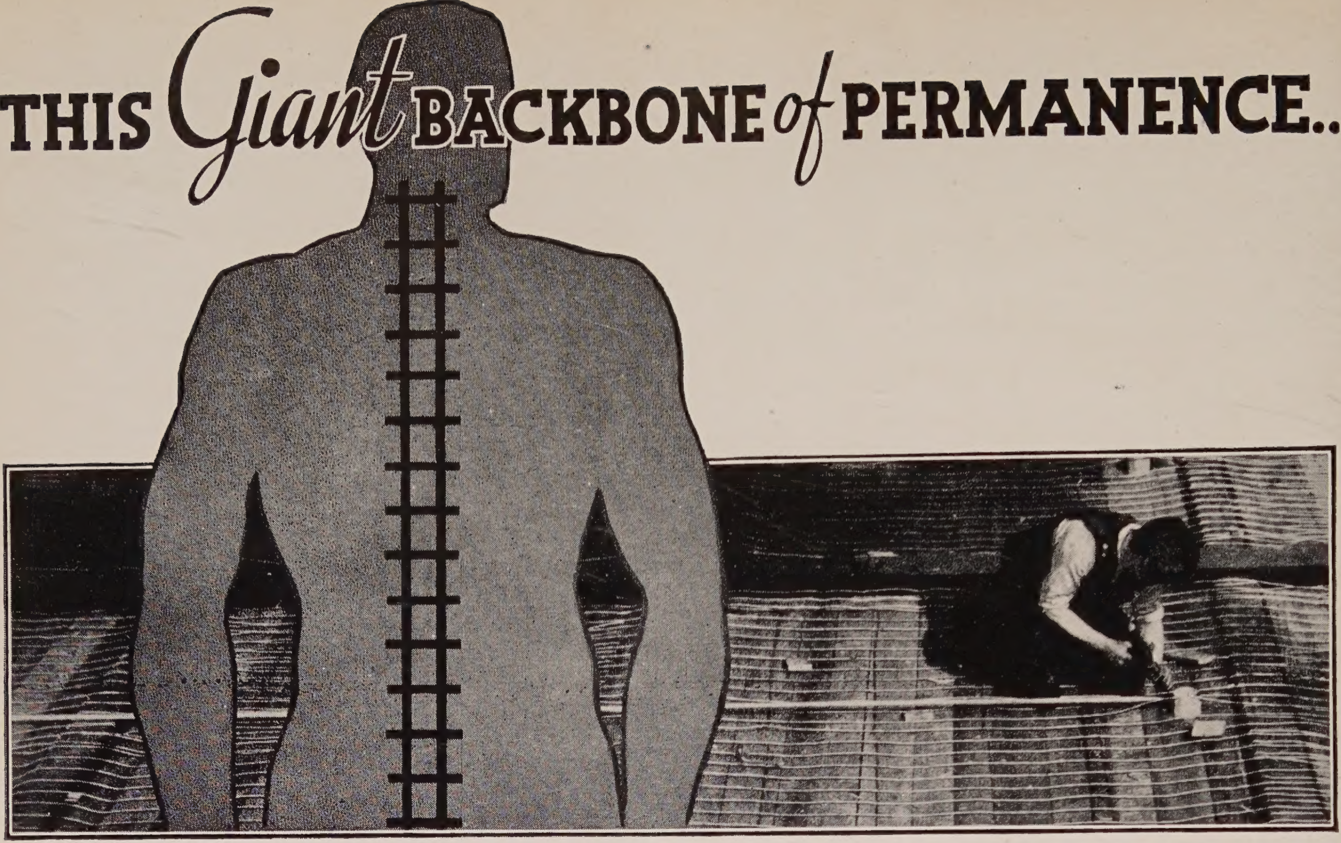
◖ This means, then, that the $1,140 yarn was just another sample of the misinformation that is being spread over the country by the host of newspaper men and writers of "business service" sheets who are infesting Washington.

◖ And did any of them send out corrections? They did not. They calmly sent out other stories of how the supposed Hopkins ruling had been "rescinded." One paper even congratulated the President on his wisdom in reversing Mr. Hopkins!

◖ The automobile industry has enjoyed complete recovery because its leaders have had the good sense to manufacture automobiles instead of worrying about Washington.

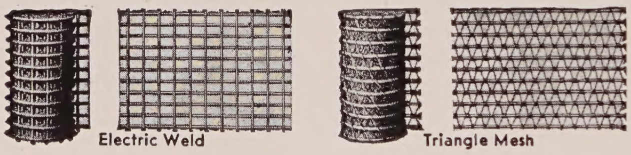
◖ When the so-called leaders of the construction industry acquire enough sense to throw their "business service" sheets into the waste basket and quit worrying about Washington, their business will experience a recovery as complete as that of the automobile industry.

THIS *Giant* BACKBONE *of* PERMANENCE..



..IS EASY TO HANDLE

FURNISHED IN ROLLS OR SHEETS



Build for tomorrow—but in building for the future, do not overlook today's need for speed and economy in floor slab construction. In this connection—you will find American Steel & Wire Company Wire Fabric the ideal reinforcement material. Available in rolls—it is exceptionally easy to handle—and keeps labor costs down to a minimum. This Wire Fabric—of highest quality and perfected design—reinforces the concrete slab in every direction. It provides continuous action from one end of the structure to the other—plus high elastic limits and ultimate tensile strength due to cold drawing. It is truly called "The Giant Backbone of Permanence." Interesting literature is available covering the use of this material in the nation's leading structures. This—along with technical data—will be forwarded on request.

AMERICAN STEEL & WIRE COMPANY
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Vol. XLIII, No. 8 Concrete August, 1935

New Portable Bulk Cement Plant in Concrete Highway Field

Use on Wisconsin Road Contract Demonstrates Value —Complete Installation Transported as Single Unit— Erected Quickly without Cranes

A PORTABLE bulk cement plant, built in a single, complete unit and erected in 3 hours without the use of a crane, is a new and striking feature on a concrete road construction project in Milwaukee County, Wis.

Weight and Dimensions Within Limits

This new road equipment unit is shown in transit from one job to another, in Fig. 1. The view in Fig. 2 is a close-up of the same unit, in service at the central proportioning plant that supplies the paving mixer. Fig. 3 is a general view of the proportioning plant, with the portable bulk cement plant in the foreground and two aggregate bins to the rear. At the left, a dump truck is delivering a cargo of bulk cement.

Referring further to the portable bulk cement plant, it is designed so that it can be transported over any highways without the need of obtaining a special permit. The clearance is 13 ft., and the width of the unit when being transported is within the width allowed for commercial vehicles on highways. The weight is 9,000 lb. on the rear axle and 5,000 lb. on the front. Erection of the bulk cement plant is accomplished with the aid of a one-man winch, provided as a part of the unit and shown in Fig. 1.

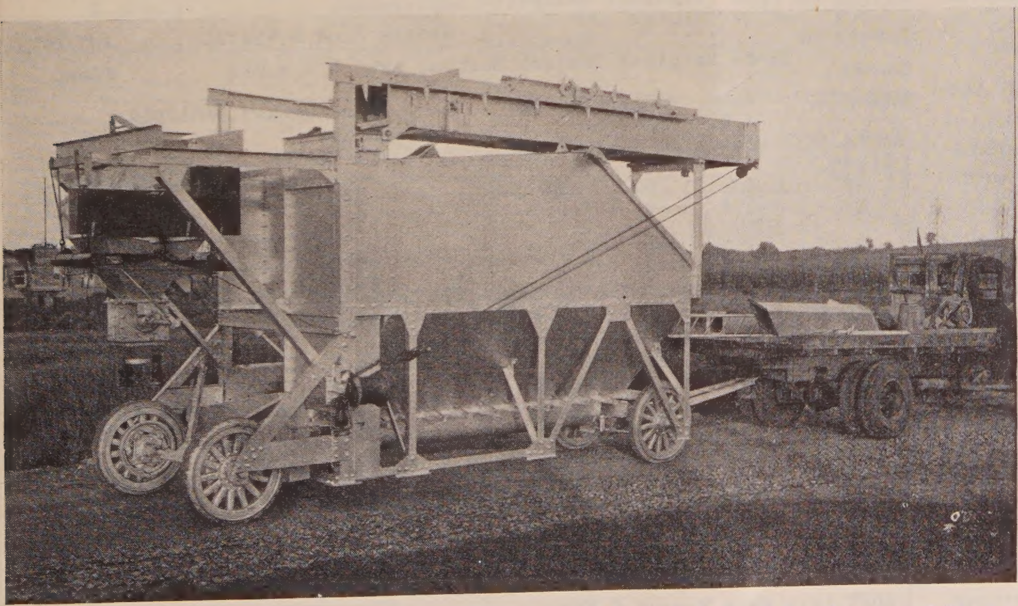
Mechanical Features

The portable unit has a 100-bbl. bin into which dump trucks deliver their cargoes of bulk cement from a ramp built for the purpose (See Fig. 3, at left). From the bin the cement is carried horizontally by a screw conveyor and discharged into the boot of a vertical bucket elevator, which in turn discharges into the cement-weighing hopper shown most clearly in Fig. 3. Here the cement batches are weighed by the standard weighing batcher made by the Butler Bin Company, manufacturers of the portable unit. Fig. 3 also shows the return chute through which any overflow of cement is returned to the bin.

The bulk cement plant is designed so that it may receive cement direct from under-track screw conveyors installed for unloading hopper-bottom bulk cement railway cars. Where cement is received in ordinary railway box cars—this will be the case on the next job to which this unit is going—it is usually unloaded by means of 2-wheeled scoops.

Central Proportioning Plant

The central proportioning plant of which this bulk cement unit is a part, is located at the intersection of Routes 100 and 15, in Milwaukee County, Wisconsin. Each of the two aggregate bins shown in Fig. 3 is divided into two compartments, thus providing four compartments—one for sand and one for each of the three sizes of coarse aggregate used on this contract. The aggre-



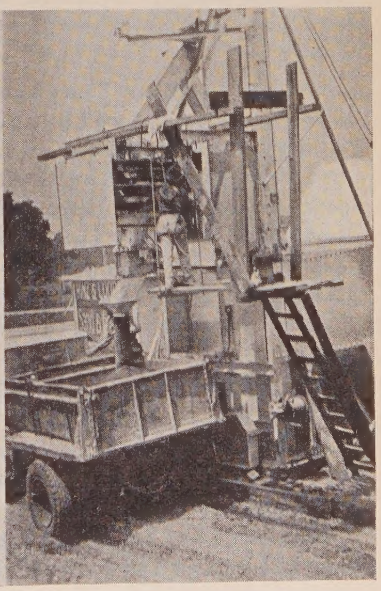


Fig. 1 (Left): Portable bulk cement plant, a complete unit on wheels that is quickly set up on the job, is new feature on Wisconsin highway contract. Fig. 2 (Right): The same portable unit set up and operating on the job

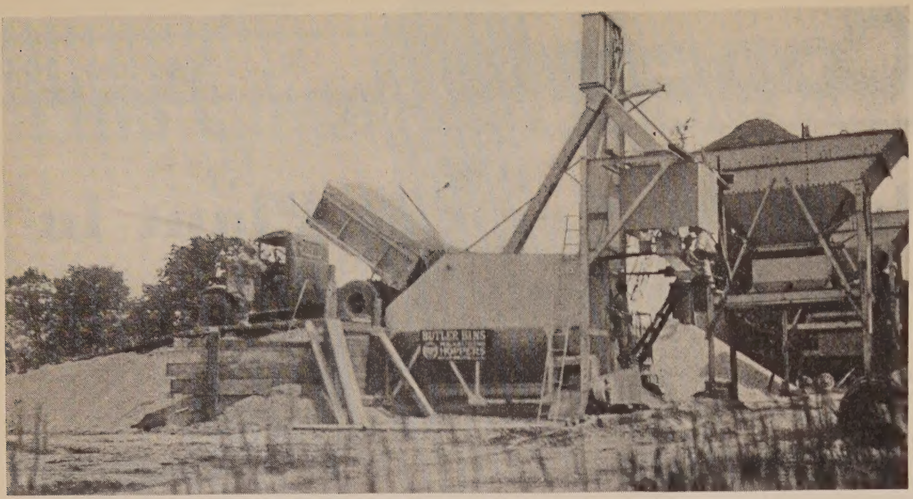


Fig. 3. Central proportioning plant with new portable bulk cement plant in foreground; aggregate bins to the rear

gates are brought to the central proportioning plant from a point 8 miles away, by a fleet of ten dump trucks, and are handled on the job by a clamshell. Another fleet of ten dump trucks is employed in hauling the bulk cement—in 30-bbl. loads—from the Milwaukee storage terminal of a cement manufacturing company. This haul is 8½ miles. A third fleet of eight dump trucks is utilized in transporting the batches to the paving mixer—an average distance of 1½ miles. Thus the total number of dump trucks employed on this contract is twenty-eight.

All Proportioning by Weight

The trucks that take on batches at the central proportioning plant also are divided into two compartments, each compartment containing material for one batch of concrete. Each truck gets its load at three points—first, at the more distant bin in Fig. 3, where the two larger sizes of coarse aggregate are taken on; then to the next bin, where the sand and pea gravel are taken; then to the portable cement plant, where the cement is weighed out. Fig. 2 shows a truck getting its final charge of cement. All proportioning of materials is by weight.

The contract served by this central proportioning plant is a 30-ft. concrete pavement 2.4 miles long. Placing of concrete was started about the middle of July.

Acknowledgments: The contractor on this work is John Vanderheyden, Inc., 1901 West Canal St., Milwaukee. The portable bulk cement unit here described and illustrated was manufactured by the Butler Bin Company, of Waukesha, Wisconsin. The unit is to be used soon on another contract in the same vicinity.

Concrete Mix Design Applied to Varying Aggregates

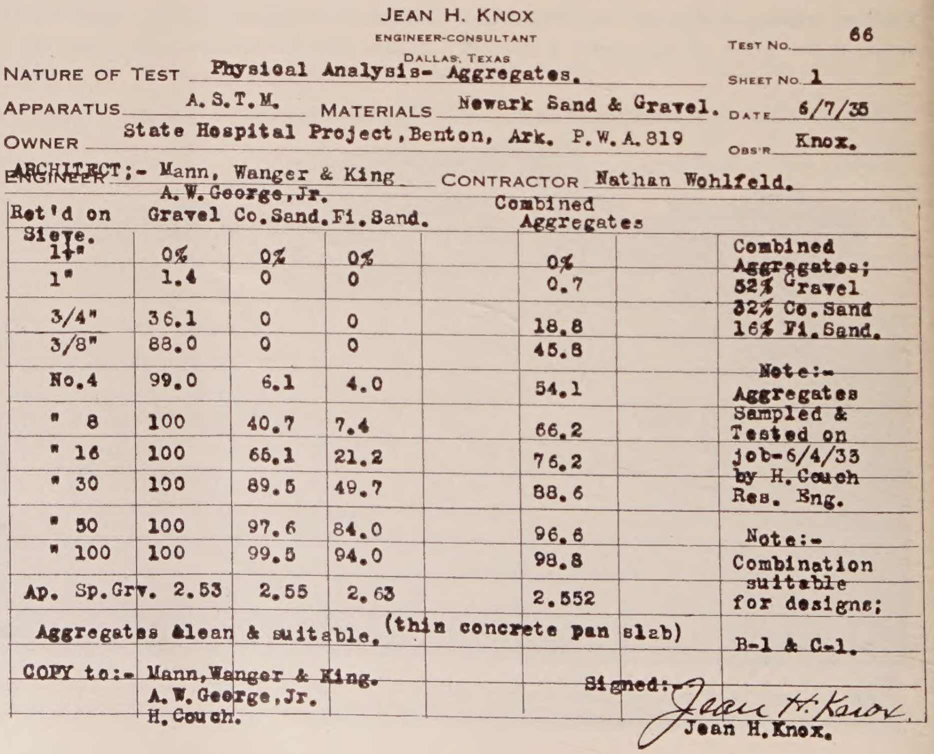
By JEAN H. KNOX
Engineer-Consultant, Dallas, Texas

THE writer enjoyed reading the article in your June issue on "Concrete Mix Design," by F. N. Menefee, discussing methods proposed by H. N. Walsh.

The accompanying "test report" furnishes an actual typical illustration of the method described. It is self-explanatory. For a number of years the writer has employed the sound theories introduced by Fuller, and has developed a method of analysis and concrete design particularly applicable to the varying physical characteristics of concrete aggregate.

Our own experience does not check out the outline in the Menefee article, since we have found that surface areas, shape of particle, grading, the combined coarse and fine aggregates (cement excluded) may not be approximated by empirical rule, and also that these same physical characteristics must determine the amount of cement necessary, then the paste necessary (cement plus water).

Since the important factors for manufactured concrete or other cementitious products are uniformity, durability and impermeability, with strength a secondary consideration, a rule may be general, but does not suffice for the ever-changing job conditions and materials.



JEAN H. KNOX
ENGINEER-CONSULTANT
DALLAS, TEXAS

TEST NO. 66
NATURE OF TEST Physical Analysis- Aggregates.
SHEET NO. 1
APPARATUS A.S.T.M. MATERIALS Newark Sand & Gravel.
DATE 6/7/35
OWNER State Hospital Project, Benton, Ark. P.W.A. 819
OBS'R Knox.
ENGINEER ARCHITECT;- Mann, Wanger & King
A.W.George,Jr.
CONTRACTOR Nathan Wohlfeld.

Ret'd on Sieve.	Gravel	Co.Sand.	Fi.Sand.		Combined Aggregates		
1½"	0%	0%	0%		0%		Combined
1"	1.4	0	0		0.7		Aggregates; 52% Gravel
3/4"	36.1	0	0		18.8		32% Co.Sand 16% Fi.Sand.
3/8"	88.0	0	0		45.8		
No.4	99.0	6.1	4.0		54.1		Note:- Aggregates
" 8	100	40.7	7.4		66.2		Sampled & Tested on
" 16	100	65.1	21.2		76.2		job-6/4/33
" 30	100	89.5	49.7		88.6		by H.Couch Res. Eng.
" 50	100	97.6	84.0		96.6		Note:-
" 100	100	99.5	94.0		98.8		Combination suitable
Ap. Sp.Grv.	2.53	2.55	2.63		2.552		for designs;
Aggregates clean & suitable. (thin concrete pan slab)							B-1 & C-1.
COPY to:-	Mann,Wanger & King. A.W.George,Jr. H.Couch.					Signed:- Jean H. Knox Jean H.Knox.	

Fireproof Buildings
Below Cost of Wood Frame

Monolithic Type Uses Known Methods and Materials—Metal Lath Association Urges Fireproof Construction for Smaller Buildings—Big Chance for Concrete Contractors

A NEW combination of materials that are well known in ordinary methods of fireproof building construction, is being brought to the attention of the construction industry through the Metal Lath Manufacturers' Association, of Chicago. It produces a rigid type of construction, with walls completely insulated. All metal parts in walls and partitions are completely protected by portland cement mortar, while in the floors and roof the metal may be fully protected or partly exposed.

Small Fireproof Buildings

The construction method was developed particularly for buildings of comparatively small size, such as individual homes, small school buildings and churches, and for smaller buildings such as filling stations, overnight tourist cottages, lake cottages, private garages, and similar structures. Erwin M. Lurie, secretary of the Metal Lath Manufacturers' Association and developer of this method of construction, believes the time is here for the general use of fireproof construction for buildings of these smaller types, and for the development of a practicable working procedure. For these reasons he has confined the required materials to light structural steel shapes that are readily available, and to steel bars, metal lath and portland cement concrete, mortar and stucco, all of which involve the use of materials that can be obtained anywhere.

Uses Known Methods

Likewise, the application of these materials involves nothing new. Parts of the structural frame such as light steel roof trusses can be fabricated at any small iron works, from materials carried in stock. On the job all steel frame work is *bolted* into place, no riveting or welding being required.

Briefly described, the Lurie steel house, as this type is called, is a concrete-armored steel structure. It consists of a thin non-bearing, ribbed concrete mortar or gunite envelope, 2 in. thick, attached to and supported by a structural frame which takes the dead and live loads, and a separate inside plastered wall to form a continuous hollow space around the building.

The structural frame, usually of steel, may be of reinforced concrete or other materials. The structural columns are spaced 8, 10 or 12 ft. on centers, as required. The concrete envelope is designed to carry its own weight and to distribute the wind stresses to the structural frame. Plastering channels of ¾-in. size are attached to the structural frame, and galvanized metal lath is tied to these channels. Portland cement mortar mixed 1:3 or 1:4 is then applied to the lath. A ¼-in. scratch coat is applied to the outside of the lath. Additional coatings of mortar are then applied as plaster, or gun work, burying the channels and lath in a continuous reinforced concrete envelope. This concrete is 2 in. thick, except that where horizontal and double vertical ribs occur it is 3 to 3½ in. thick.

For the inside face of the walls, ¾-in. steel channels are then attached by spreaders to the vertical channels in the exterior concrete envelope. Metal lath is tied to these inside channels, and plaster is applied. The entire wall weighs only 25 lb. per sq. ft. of wall area.

Partitions, Floors and Roof

Interior partitions are of 2-in. solid metal lath and plaster, to conserve floor space; or, where necessary to accommodate ducts, pipes or conduits, hollow partitions of the same materials are recommended.

Floors may be built of pre-fabricated steel rod joists or junior or standard beam joists, covered with ribbed metal lath and 2 in. of concrete; or a floor of ordinary reinforced concrete or of precast concrete joists may be utilized, where complete protection of the metal is desired.

For the roof construction—that is, for pitched roofs — the most economical construction will usually consist of light fabricated steel trusses, over which is placed a covering of ribbed metal lath and 2 in. of cement mortar or gun work. In this case it is necessary to attach horizontal strips for the placing of roofing tile or fire-resistive shingles, the

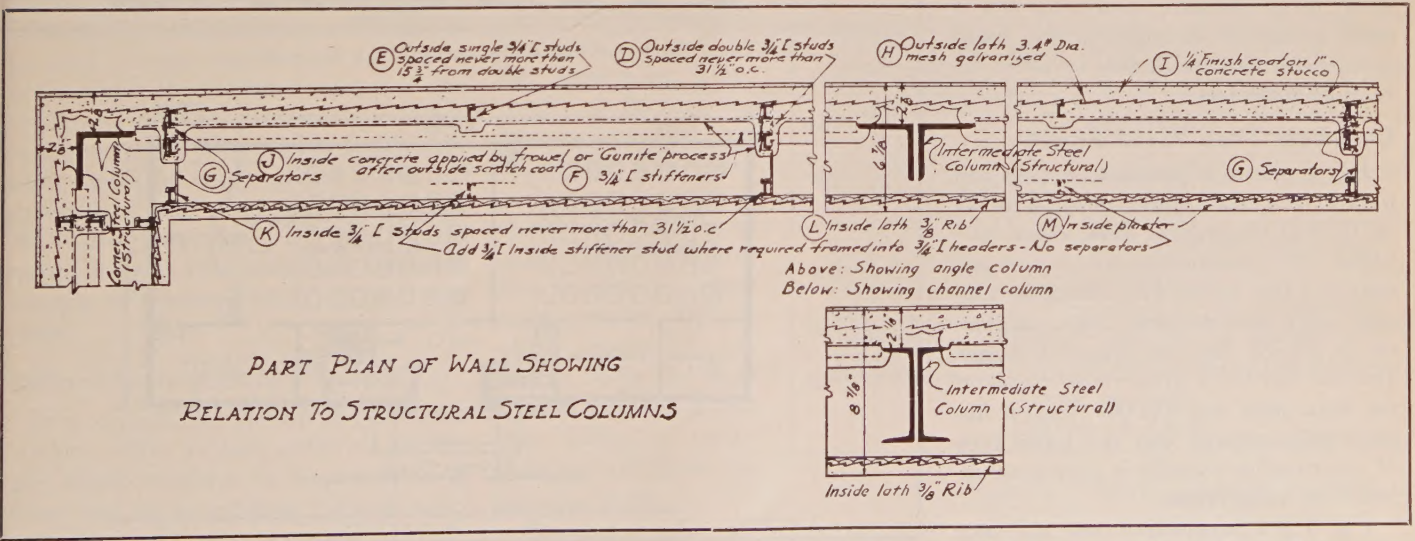

Ⓔ Outside single 3/4" [studs spaced never more than 15 3/4" from double studs
Ⓓ Outside double 3/4" [studs spaced never more than 31 1/2" o.c.
Ⓗ Outside lath 3.4# Dia. mesh galvanized
Ⓘ 1/4" Finish coat on 1" concrete stucco
2 3/8"
2 3/8"
Corner Steel Column (Structural)
Ⓙ Inside concrete applied by trowel or "Gunite" process after outside scratch coat
Ⓖ Separators
Ⓕ 3/4" [stiffeners
6 7/8"
Intermediate Steel Column (Structural)
Ⓖ Separators
Ⓚ Inside 3/4" [studs spaced never more than 31 1/2" o.c
Add 3/4" [Inside stiffener stud where required framed into 3/4" [headers - No separators
Ⓛ Inside lath 3/8" Rib
Ⓜ Inside plaster
Above: Showing angle column
Below: Showing channel column
PART PLAN OF WALL SHOWING
RELATION TO STRUCTURAL STEEL COLUMNS
2 1/8"
8 7/8"
Intermediate Steel Column (Structural)
Inside lath 3/8" Rib

Fig. 1. Details of wall construction, showing method of constructing outer and inner parts of exterior wall

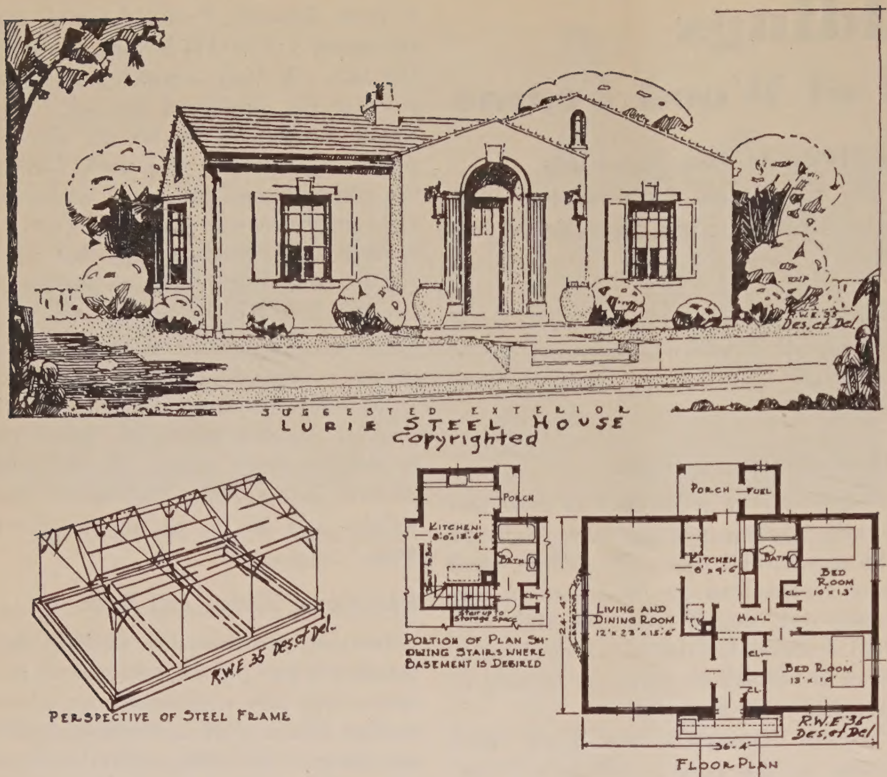


Fig. 2. Bids on this 4-room home were lower than for wood frame building drawn on same plan

strips being secured to anchor sockets embedded in the cement mortar.

Details of Wall Construction

On the exterior surface, a finish coat of portland cement stucco is applied.

Details of the exterior wall construction are shown in Fig. 1. From this it will be seen that the only contact between the outer and inner parts of the wall occurs at sills and at the spreaders between the vertical channels, these spreaders being spaced 32 in. each way. The space between the outer and inner parts is available for pipes, ducts, and conduits. This complete air space, in itself, forms effective insulation; but if more insulation is required, the space is available for quilt, fill, or other insulating materials.

Cost Less Than Wood Frame

Fig. 2 shows a perspective view and plan of a 4-room home, 24 ft. 4 in. by 36 ft. 4 in. in general dimensions, prepared for construction in a Chicago suburb. The lowest bid, based on Chicago labor and material costs, amounted to $3,750 for the fireproof house. The low bid for a wood frame house of the same plan was $4,000. Thus it has been demonstrated that the Lurie type of construction actually is more economical than wood frame.

Fig. 3 is a perspective view and floor plan of a 2-room country school building, on which bids are to be received at an early date.

Great Lateral Strength

The great lateral strength of this type of wall construction, quite evident from casual examination, has been demonstrated by means of tests conducted at the Washburne Apprentice School, in Chicago, by Rex L. Brown, of the University of Illinois.

Fig. 4 shows the testing equipment devised for the purpose. It consisted of a horizontal steel frame of two I-beams, resting on two arms that extended to the opposite side of the test panel. These two arms were anchored by means of gusset plates to two vertical I-beams placed at the back of the test panel (but not connected with it), and these in turn were riveted to horizontal I-beams at the top and bottom of the test panel.

The test panel itself (shown in Fig. 5) was 95 in. high (measured between I-beams), and 96 in. wide—practically 64 sq. ft. in area. The test load was applied at the face of the panel, on a horizontal line midway between top and bottom, by means of a jack screw with a dynamometer attached. While the official report is not yet available, observers of the wall test were surprised at its great lateral strength.

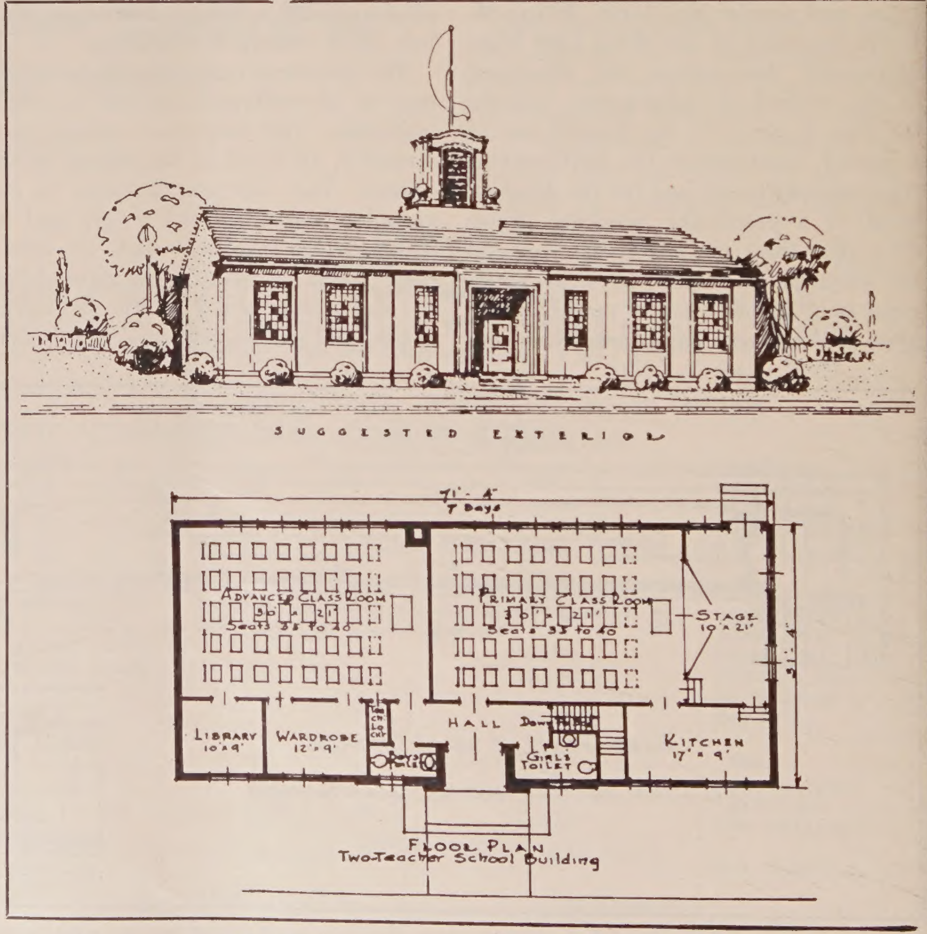
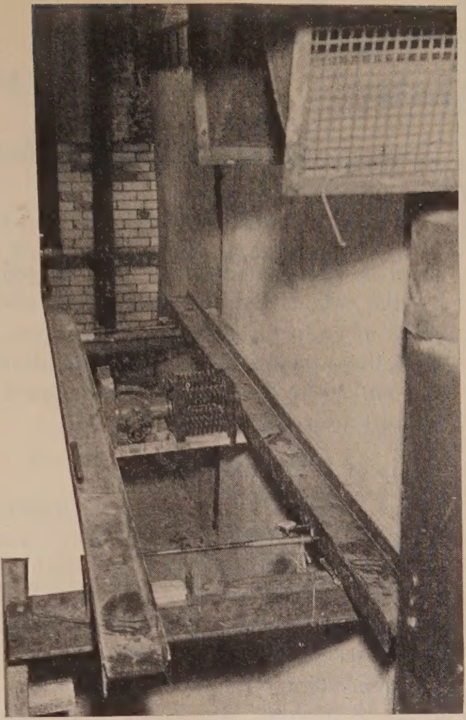


Fig. 3. Two-room country school building

Concrete Contractors' Big Chance

Patents have been applied for by Erwin M. Lurie, secretary of the Metal Lath Manufacturers' Association, who, as previously stated, developed this method of construction. Basic claims recently were granted. The patents are not to be exploited as such, but are being taken out as a protection against possible claims of other patentees.

There is no question that this method of construction offers an outstanding opportunity for local concrete contractors to extend their field of activities to include the construction of fireproof buildings ranging in size from schools, churches and dwellings, down to private garages and tourist cottages. With the Metal Lath Manufacturers' Association standing back of him, any enterprising local contractor may soon become known as the community's fireproof construction man. Being the first in the field, he will have a definite start on any competitors who may follow.



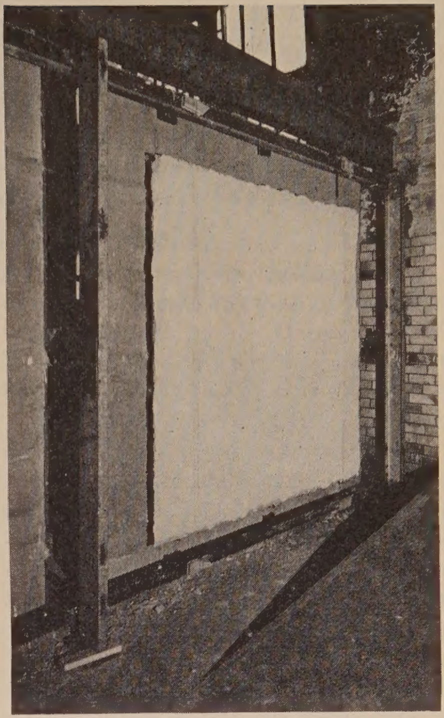


Fig. 4 (at left): Testing equipment for testing lateral strength of wall.
Fig. 5 (at right): Wall test panel, 64 sq. ft. in area

Cinder Concrete Building Units Will Not Corrode Steel

THE question as to whether cinder concrete building units will corrode steel is frequently raised because of the knowledge that damp cinders do have a corrosive effect on metals, says a recent information bulletin issued by the Portland Cement Association.

Any corrodible metal will rust if subjected to alternate wetting and drying in the presence of air. It is therefore essential to provide adequate protection against moisture. In foundation walls and in certain types of structures, such as cold storage warehouses and laundries, where the moisture content of the air is very high, it is advisable to adopt some protective measure for any corrodible metal in unit masonry walls, regardless of the composition of units. No cases have been reported which would indicate that metal was corroded because of contact with dry cinder concrete.

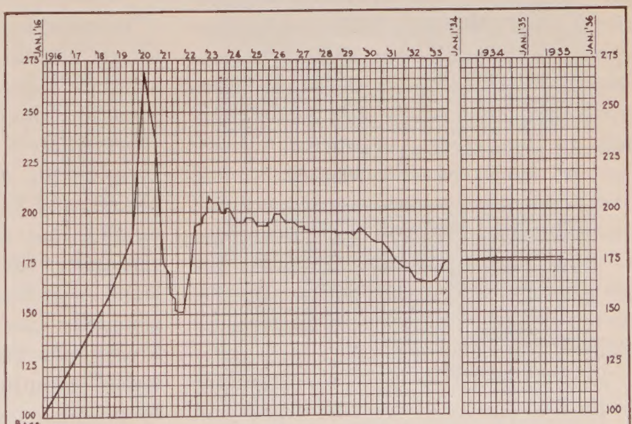
Sulfur Compounds Neutralized

It is argued that the sulfur content in cinders, either as free sulfur or as SO_2 gas, would combine in the presence of water and air to produce sulfuric acid; that this acid, in turn, would corrode any metal with which it came in contact. This reasoning is not sound, when cinders are used with portland cement, for the following reason:

Any sulfur compounds present in such a state that they would form sulfuric acid would be so formed with the addition of the mixing water. The addition of portland cement, which is strongly alkaline, to this wet cinder mixture would quickly neutralize any acid that might be present. The chemical reaction between the portland cement and the sulfuric acid would result in the formation of a small quantity of calcium sulfate, which is one of the constituents of portland cement.

Aberthaw Index of Building Cost

THERE is no change in the construction cost index issued by the Aberthaw Company, of Boston, for the quarter ending June 30, 1935. The index value continues to stand at 176.5 — the same value shown for five consecutive quarterly periods. Only a slight change has occurred since the final quarter of 1933, a fact that indicates rather definite stability in construction costs.



The index value of 176.5 represents a cost of $1.85 per sq. ft. of floor area for the 7-story industrial building of reinforced concrete construction, on which the computations are based.

Cast Stone Samples for Color and Finish

Washington Meeting Results in Improved Arrangements for Distribution of Standard Samples

At a general conference on colors and finishes for cast stone, held in Washington, D. C., on May 17, under the auspices of the National Bureau of Standards, a Recommended Commercial Standard (TS-2126) was adopted.

As will be seen from the action taken at this meeting, further steps were taken toward perfection of the arrangement whereby standard samples may be distributed for the information of architects and specification writers. Previous accomplishments in this direction were reported in CONCRETE in the issues of July (1932), page 12; in August (1932), page 16; and in April (1933), page 12.

This standard covers those colors and finishes which constitute a very large proportion of the production of the cast stone industry. As the demand arises this standard may be extended to include other colors and finishes.

Purpose

As usually written, specifications on the appearance of cast stone are subject to widely different interpretations by different manufacturers, which leads to confusion and misunderstanding. While such attributes as strength, density and absorption can be definitely specified and easily measured by tests, appearance is intangible and is not susceptible to a written description which is definite enough to have but one interpretation. From the standpoint of the responsible manufacturer it is extremely important that specifications be complete and clear, since he can not submit an intelligent competitive bid unless he knows exactly what is wanted and what other manufacturers will bid on. This standard provides a solution of these difficulties by simplifying the preparation, interpretation and enforcement of specifications on colors and finishes for cast stone.

It is not the purpose of this standard to limit the range of colors, textures and finishes in cast stone. Under its present scope it merely sets up tangible examples of the most frequently occurring colors and finishes. These samples provide standards of comparison by which cast stone of these particular colors and finishes can be specified and judged. To the extent that they exemplify cast stone of enduring and pleasing appearance these samples provide a standard of comparison for all cast stone, regardless of color and finish.

Basis of Standardization

The principles and practices underlying the manufacture of cast stone are of such uniform and constant application as to permit a very close control of the color and finish of the finished product. Cast stone can be made to meet any reasonable predetermined requirements as to color and finish; one manufacturer, if he desires, can satisfactorily duplicate the product of any other manufacturer.

The factors which affect the appearance of cast stone are color of aggregate, size and grading of aggregate, pigment, cement, proportions of mix, method of molding, and nature and extent of surface treatment. Without any attempt to define or restrict materials and methods used in producing cast stone, uniform results as to appearance can be obtained by establishing a definite visual standard to which manufacturers can conform. Judgment as to color and finish of the product can then be made without reference to how the results were obtained.

Method of Making Comparisons

In matching the original sample, materials similar to those comprising the standard sample may be used, but substitutions should be limited to the same representative class of materials as those forming the standard sample. It is expected, and has previously been demonstrated, that raw materials of sufficient similarity for the production of cast stone matching a given sample are generally available to manufacturers throughout the country. Standard reference samples of cast stone therefore in no wise restrict competition among manufacturers, but instead tend to broaden and equalize competition. Of equal importance, standard reference samples will provide a means by which purchasers of cast stone can specify exactly what is desired and a standard by which the delivered product can be judged as to appearance.

In making comparisons with standard reference samples, observations shall be made from a distance of ten feet. The surfaces being compared shall be in the same vertical plane. Comparions shall be made by the light from a northern sky. A neutral gray mask with two apertures four inches square and six inches apart shall be used to expose equal areas of the two surfaces to be compared. The surfaces being compared shall be considered to match satisfactorily if there is no appreciable difference in their appearance under the specified conditions of comparison.

Arbitration Committee

Final decision in the settlement of misunderstandings, disagreements or disputes arising from claims concerning off-color or finish samples or shipments may be made by the following committee:

A representative from each of the following organizations:

American Institute of Architects.
Portland Cement Association.
The Cast Stone Institute.
Division of Clay and Silicate Products, National Bureau of Standards.
Division of Trade Standards, National Bureau of Standards.

Standard Samples

The proposed standard colors and finishes for cast stone shall be designated in Table 1.

TABLE 1—PROPOSED STANDARD COLORS AND FINISHES FOR CAST STONE

Designation	Color	Finish
SS-10A	Gray	Rubbed
SS-10B	"	"
SS-10C	"	"
SS-20A	Gray	Bush-hammered
SS-20B	"	"
SS-30	Gray	Etched
SS-40	Gray	Brushed
SS-15A	Buff	Rubbed
SS-15B	"	"
SS-15C	"	"
SS-25A	Buff	Bush-hammered
SS-25B	"	"
SS-35	Buff	Etched
SS-45	Buff	Brushed

The original standard color and finish samples shall be retained at the National Bureau of Standards. Reference samples (4½ by 6½ by 1 in.), certified by The Cast Stone Institute as constituting satisfactory duplicates of the master samples, for use by manufacturers in production control, may be obtained from The Cast Stone Institute at $2.50 each in lots of four or more, and $3.00 each in lots of less than four.

Salvage
Old Brick Streets
with Cement-Bound Macadam

Old Paving Brick or Stone Crushed and Replaced as Coarse Aggregate for New Pavement—Method Employs Many Men

Placing cement-bound macadam pavement in New Jersey with unskilled labor

ROUGH and rutted city street pavements surfaced with paving brick or stones may be re-surfaced at low cost—and with the highest ratio of expenditure for labor—by taking up and crushing the old brick or stone, then utilizing the broken material as the coarse aggregate in a new cement-bound macadam surface.

Because of the lack of funds for pavement construction and maintenance of pavements, and the consequent neglect of city streets for four or five years, street pavements on the average are in the worst condition experienced since hard-surfaced pavements came into vogue. In numerous cities the lack of funds still serves as a definite hindrance to street improvements, though miles of pavement have reached an intolerable condition.

A Permanent Improvement

Faced with this situation, alert city engineers can overcome their difficulties by salvaging the old pavements in the manner suggested above—by breaking up the old brick and stone and using the crushed material as coarse aggregate for a new cement-bound macadam surface. In this way, the reconditioning of intolerably rough streets may become the most useful type of project for the expenditure of funds out of the $4,800,000,000 Work Relief Act. Projects of this type will be ideal for local work—especially for those costing less than $25,000, all of which come under the jurisdiction of the Works Progress Administration headed by Harry L. Hopkins. The suitability of such paving projects will be evident for the following reasons:

(1) They meet the basic requirements, set forth by the President, that all work undertaken should be useful—not just for a day or a year, but useful in the sense that a permanent improvement is created.

(2) Salvaging of the old paving brick or stone, and their use in a new cement-bound macadam pavement, means that a high percentage of the expenditure will be for labor.

(3) A large part of the labor employed may be unskilled.

(4) Local materials will be used exclusively. These include sand and cement and some additional coarse aggregate, together with the salvaged brick and stone.

(5) Any vitrified paving brick, when crushed and used as coarse aggregate, produces a cement-bound macadam pavement that is high in strength and in resistance to wear.

It Can Be Done

Savannah, Georgia, has taken the lead in demonstrating that this method of re-surfacing old street pavements is both practical and economical.[1] During 1934 that city, under the direction of A. S. Goebel, city engineer, re-surfaced 75,000 sq. yd. of old brick pavement in this manner—the equivalent of 4.2 miles of pavement 30 ft. wide.

In consequence, the experience gained in Savannah—and in other cities as well—may be used as a guide by the engineering departments of other cities.

Equipment Easily Obtained

First of all, consider the equipment required, all of which is likely to be found among the regular equipment in the hands of the city street superintendent or the county road supervisor. From some such source the needed equipment can either be borrowed or rented. In general, the required equipment will include—

(1) Several motor trucks for hauling equipment and materials.

(2) A crusher, to crush the old paving bricks or blocks, unless this work is done by hand.

(3) A stone spreader, consisting of a large hopper box of the type illus-

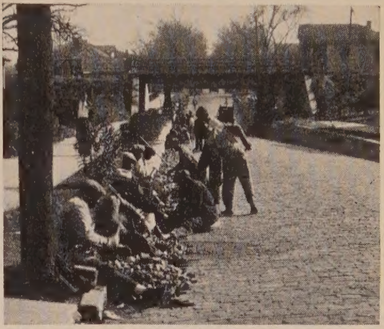


Fig. 1—Crushing the old paving brick by hand employs many men

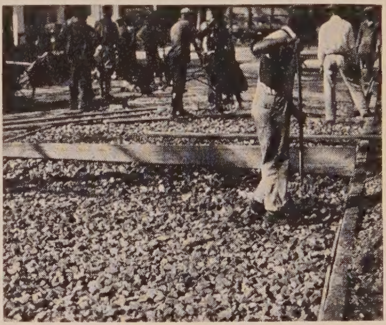


Fig. 2—Spreading the broken brick as aggregate for cement-bound macadam

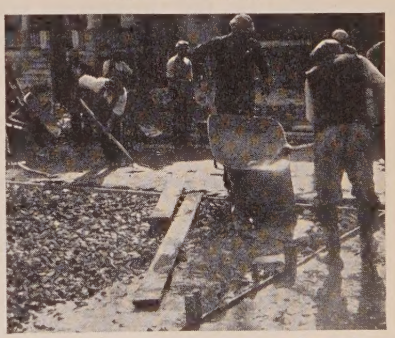


Fig. 3—Placing and spreading the cement-and-sand grout

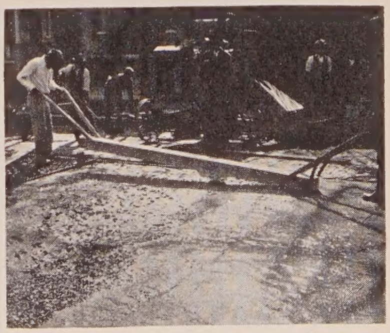


Fig. 4—A hand tamper, a 6 by 6-in. timber, 12 ft. long, with plow handles on each end

trated on page 5 of the January (1933) issue of CONCRETE.

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[1] Detailed *Specifications for Salvaging Old Brick Streets by the Cement-Bound Macadam Process* may be obtained, without charge, from the Portland Cement Association, 33 W. Grand Ave., Chicago.

(4) A tandem roller, weighing from 3 to 6 tons.

(5) Several small concrete mixers, for mixing grout.

(6) A plow-handled tamper, as illustrated in Fig. 4.

(7) Wheelbarrows and hand tools.

Crush Bricks by Hand

The question of using a mechanical crusher to break up the old paving brick or stone, or doing this work by hand, is largely a question of the number of men to be employed. There is one distinct advantage, however, in favor of hand-work—experience in Savannah disclosed that mechanical crushers produced a much greater quantity of undersize material (less than ¾ in.). This undersize material, of course, is wasted, except that some of it may be used in filling low places in the subgrade.

The Work Procedure

The procedure at Savannah may be regarded as typical, though variations in procedure will necessarily occur.

In Savannah the old paving brick was broken by hand, the sizes of the broken pieces averaging about 2½ in., with no pieces more than 3 in. Uniformity in size of coarse aggregate is highly desirable, but for practical reasons the effort to gain uniformity should not be carried too far. In general, sizes of coarse aggregate on any one job should vary by not more than 1 in. from the minimum to the maximum. Thus, on a single project the size might vary from 1 in. to 2 in. or from 1½ to 2½ in. No coarse aggregate smaller than ¾ in. should be used in cement-bound macadam work, while 3 in. may be regarded as the upper limit.

Spreading and Tamping

Other workmen spread the broken brick over the subgrade with stone forks, which screened out the fine material. Here, again, the spreading can be done with the hopper-box spreader mentioned above in numbered paragraph (3).

The next process involved tamping of the spread layer of broken brick, by means of the tamping device shown in Fig. 4. This consisted of a dressed timber 6 in. square and 12 ft. long, fitted with plow handles at each end. The tamper was operated parallel to the center line of the street. The brick in the pavement, when broken, was not quite sufficient to produce the necessary thickness of 5 in. To make up the deficiency, a small quantity of crushed granite, ranging from 1 to 2 in. in particle size, was thrown over the layer of broken brick.

Grouting

Grout was then applied. This was proportioned 1:2 by weight; but because of the bulking of the sand, measured proportions were 1 sack of portland cement to 2¾ cu. ft. of damp sand, loose measure. The cement-and-sand grout was mixed in a small 10-S concrete mixer, and was taken in wheelbarrows over plank runways to the place of deposit. Here it was dumped on to a small board platform, to avoid disturbing the coarse aggregate, and from the platform the grout was pushed forward with stiff brooms.

The grouted slab was then promptly tamped with a plow-handle timber similar to the one used in the original tamping of the coarse aggregate. This tamping action caused a certain amount of vibration, which aid penetration of the grout. Then the surfcace was checked with a straight-edge, and inequalities were corrected.

It should be added here that on many cement-bound macadam projects the grout is delivered in transit concrete mixers and dumped through swinging chutes into suspended boxes having 1-in. holes drilled into the bottom. This insures a vertical fall of the grout and avoids disturbance of the aggregate. Likewise, on many projects, high-frequency vibrators[2] are employed to insure complete penetration of the grout.

Finishing and Curing

The work in Savannah was given its final finish by means of long-handled floats, followed by dragging a strip of burlap over the surface.

Curing the pavement was accomplished by means of sprinkling during the first 24 hours, after which the surface was covered with earth and kept wet for six days.

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[2] Commercial vibrators have been developed for this purpose.

Sixteen States Pass Housing Measures

Seven Others Have Similar Laws Pending—Ohio Leads in Activity

IN a memorandum dealing with state housing authority legislation which Ira S. Robbins, counsel to the New York State Board of Housing, recently submitted to the Congressional Committee on Education and Labor, the following sixteen states were listed as authorizing local housing authorities: Alabama, Colorado, Delaware, Illinois, Kentucky, Michigan, Montana, Nebraska, New Jersey, New York, North Carolina, Ohio, Rhode Island, South Carolina, Tennessee, and West Virginia.

Ohio leads the list of states with housing legislation, with the greatest number of cities having housing authorities—seven, including Cincinnati, Cleveland, Columbus, Dayton, Toledo, Warren and Youngstown. New York follows with three—Buffalo, Schenectady, and New York City. South Carolina has two — Charleston and Columbia, while of the remainder, Illinois, Kentucky, Michigan and Nebraska have one each. Cities authorized to do so by other states have not yet appointed authorities.

The following states now have housing authority legislation pending: California, Florida, Indiana, Massachusetts, Minnesota, Pennsylvania and Wisconsin. Mississippi and Virginia have both indicated that they will take action on such legislation during the 1936 sessions of their respective legislatures. Five states have either rejected, or expressed no interest in housing legislation. These five are Georgia, Louisiana, New Mexico, New Hampshire and South Dakota.

Coming Conventions

Oct. 14-16—Public Works Engineering Conference. Joint Meeting of the American Society of Municipal Engineers and International Association of Public Works Officials, Cincinnati, Ohio.

Oct. 14-18—National Safety Council. 24th Annual Safety Congress. Louisville, Kentucky. A. J. R. Curtis, 33 West Grand Avenue, Chicago, Secretary Cement Section.

Oct. 15-16—Institute of Traffic Engineers. Sixth annual. Louisville, Ky.

Dec. 9-12—American Association of State Highway Officials. Annual. Miami, Fla. W. C. Markham, Exec. Sec., 1222 National Press Bldg., Washington, D. C.

Rug-Cleaning Plant Is Concrete—Insurance Rate Is Low

Attractive Front of Architectural Concrete Combined with Light, Cleanliness, and Fire-Safety—Appearance of Building Brings Increased Business

By J. R. ARNOLD
Civil Engineer, Pringle & Arnold, Engineers and Contractors, Washington, D. C.

TIME was when the customer's interest in cleaning, laundry and other similar services, was merely in the appearance of the truck that drove up to the door and the quality of the finished work that was delivered. If the truck was bright and shiny, the driver courteous and the work satisfactory, the customer was satisfied. Where the work had been done—the condition of the plant, its appearance and sanitation, was either not considered important or overlooked.

Times have changed. The customer has become interested in what happens to his articles after they leave the house. He learns of the conditions under which the work is done and controls his patronage accordingly. He likes to patronize the company whose plant, as well as its service, breathes cleanliness. Attractive plants and better working conditions have resulted.

Meet All Requirements with Concrete

Fortunately, beauty in architecture does not necessitate expensive materials —nor does fireproof construction (particularly important in cleaning plants).

These points were discussed with the owner when the construction of the original two-story building of the rug-cleaning plant of E. P. Hinkel & Company, Washington, D. C., was first considered. The owner wisely wanted several things embodied in the construction of his new plant—attractive appearance, high fire-resisting qualities, good working conditions (plenty of light in the proper places). It must be constructed so that additional floors might be added without detracting from the design or appearance. With all of these requirements, the building must be economical in cost.

Because it offered all of these qualities, concrete was chosen for the job. The building was designed for three stories, two of which were built in 1929. The plant attracted attention from all parts of the country—here was the largest rug-cleaning plant in the world. Business must have been attracted too, because in January, 1935, a 15-ft. third story was added to provide additional storage space.

Entire Front Cast in Place

The structural frame of the E. P. Hinkel & Company building is of reinforced concrete throughout. The front is of architectural concrete cast in place as one monolithic unit. Side and rear walls are of concrete column and beam construction with brick curtain walls. The floors are of concrete joist design, built to carry a load of 150 lb. per sq. ft. A one-way pan system was used with a 1-2-3½ concrete mix. After troweling it smooth, the surface of the floor was given a treatment of ironite and finished with two coats of green portland cement paint. This construction produced a strong, durable, easily cleaned floor, at low cost.

The architectural concrete front, though simple in detail, is much more attractive than many commercial buildings, which too often have been designed to be strictly utilitarian with little thought being given to appearance.

With the exception of the decorative urns, the entire front was cast in place. The fluting in the piers and the spandrel decorations were made by fastening wood strips and blocks to the forms. Thus, the placing of concrete and the decoration was one operation. After the forms were removed, the surface was rubbed with stone and given a coat of Min-wax.

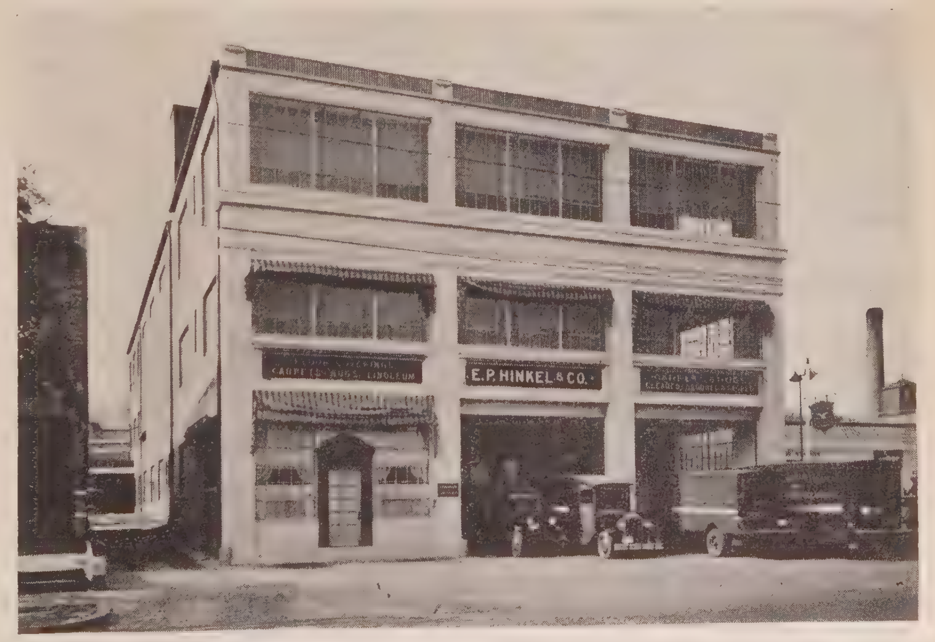
The decorative urns on the coping were precast and set in place individually. This method necessitated the use of only one waste mold. If the job were to be done over, it would be preferable to cast the urns in place, thus making the front one complete unit of monolithic concrete.

Winter Concreting

The third story addition, built in midwinter, encountered severe weather conditions. Low temperatures necessitated the heating of both water and aggregate. To assure proper curing, fires were maintained in salamanders for two days after the concrete was placed, and tubs of water were evaporated to provide moisture. Test cylinders taken from the job after seven days showed a compressive strength of 2,000 lb. per sq. in., testifying to the effectiveness of the curing methods used and the value of proper control in making concrete.

The finished building bears out the

(*Continued on page* 20)



Designed for utility, yet the monolithic concrete front adds beauty. This building claims the lowest rug-cleaning plant fire insurance rate in the country

Where Concrete Masonry Gains Prestige

Underwriters' Laboratories Inspection and Certification Service Wins Confidence of Architects Regarding Quality of Concrete Building Units

CONCRETE masonry is the only type of hollow masonry which has been awarded the Underwriters' Laboratories certification, says a concrete information bulletin issued in April, 1935, by the Portland Cement Association.

A high-class modern building is a composite of listed, labeled and certified materials and products. Many of these—sprinkler systems, fire doors, wire glass windows, window frames, elevator equipment, heating and cooling appliances and electrical installations—bear the certification of the Underwriters' Laboratories. This certification service is recognized by architects and builders as assurance, on the basis of impartial tests, that the material or product may be depended on to give satisfactory service.

Concrete masonry is the only type of hollow masonry which has been awarded the Underwriters' Laboratories certification.

This laboratory is maintained in Chicago by the fire insurance companies of the country as a means of determining the fire resistance, strength and durability of standard products. The equipment is complete; the staff is made up of recognized scientific specialists, and the data obtained through tests are supplied to insurance underwriters as the basis for establishing fire insurance rates. On the successful outcome of a test, the material or product is listed and may subsequently be given a label, stamp or certificate, attesting its proved qualities.

Fire Test of Walls

The test itself is spectacular. A panel of the material to be investigated, 10 ft. wide by 11 ft. high, is set into the face of a large gas-fired furnace. Hydraulic jacks impose on the panel a uniform "service" load of 80 lb. per sq. in. Within five minutes after the furnace is lighted, the temperature on the exposed face of the panel is 1,000 deg. F. This temperature is gradually increased according to a strict formula, until 1,925 deg. is reached at the end of three hours. Accurate temperature measurements are taken on the outer face of the panel, throughout the test, to determine the amount of transmitted heat. When the temperature on the outer face of the wall has risen 250 deg., the fire-exposure part of the test is finished; for a rise of 250 deg. from normal temperature means that combustible materials in contact with the wall are endangered and that the wall is no longer considered a fire retardant.

On the conclusion of the exposure to fire, the panel is removed from the furnace and subjected to a heavy stream of water, exactly as it would be in a fire. This "shock attack" is an extreme test of the integrity of any material. Finally, the panel is placed under doubled pressure, a test calculated to reveal any hidden structural defects.

Certified Concrete Masonry

Four major types of concrete masonry have been fire-tested and have emerged successfully. These types are (1) sand and gravel, crushed stone and slag block; (2) cinder block; (3) haydite block; and (4) stone-tile.

These four types of concrete masonry successfully withstood this series of tests without disintegration under either water or doubled load, and have received a rating of three hours as fire retardants.

The masonry units involved in the test were stock units, made to meet American Concrete Institute specifications. As a result of the tests, the Underwriters' Laboratories adopted a specification for strength which is identical with that of the Institute. Accordingly, manufacturers producing concrete masonry of the types tested, made under A. C. I. specifications, are eligible to a three-hour rating, provided the quality of aggregate used and the thickness of unit shells are in accord with the standards of the Laboratories.

An inspection service has been organized by the Laboratories to assist in maintaining high quality production in individual concrete masonry plants. Periodical tests aid both manufacturer and inspector in their mutual aim to provide builders with uniform and reliable products.

Certificates with Shipments

Underwriters' Laboratories certificates, accompanying shipments of masonry, assure the user that the units have been tested and approved. A record is kept of all certified shipments, for the guidance of insurance companies and building commissioners.

The effect of the inspection service has been not only to guarantee a high quality commodity to the user but to lower insurance rates on concrete masonry structures. At present, rating bureaus in 37 states give certified concrete masonry the same rate as solid brick construction in residences, and in 41 states they give a preferred rate over clay tile in industrial buildings, on the basis of concrete masonry's proved ability to withstand fire longer.

Building commissioners in many cities welcome the relief from frequent inspection and testing afforded by inspected masonry; they have confidence in the Laboratories and in the certificates it authorizes. Numerous building codes, both local and regional, recognize certificated concrete masonry. Notable examples are Building Officials' Conference codes for the Pacific Coast and Florida.

As a consequence of the general recognition of quality and safety accorded concrete masonry, this material is now being specified in skyscrapers, schools, hospitals, municipal buildings and industrial plants. It is used in load bearing and non-load bearing walls of every type—fire, party, panel, partition and exterior—and as fireproofing for steel members.

House Construction Leads Revival

The F. W. Dodge Corporation reports June construction contracts in 37 states east of the Rocky Mountains totaling $148,005,200, the largest since March, 1934.

Of the June (1935) total, residential building amounted to $49,832,600. This was more than 10 per cent greater than for May, and almost twice the volume in June, 1934. In fact, the June residential building total was greater than was shown for any single month since October, 1931. Non-residential building awards in June amounted to $59,035,800, while contracts for heavy engineering projects totaled $39,136,800.

◆ EDITORIAL ◆

For Self-Government of Industry

A tentative model agreement for the self-government of industry has been prepared by a joint committee representing the New York City branch of the Trade Association Executives and the American Arbitration Association, as the result of a series of meetings started on June 19. Single copies of the model agreement may be obtained without charge, from the Council on Trade Agreements, 521 Fifth Ave., New York City.

In sending out this standard form of trade agreement, the Council on Trade Agreements emphasizes the point that the document is preliminary and tentative, designed primarily as a guide and a stimulant to thought and action on the part of industrial groups and trade association executives.

While the groups responsible for the preparation of this standard form of trade agreement are to be commended for their definite and speedy action, it is unfortunate that no reference is made to existing trade agreements such as *Appalachian Coals, Incorporated*—an organization that was built on a Supreme Court decision and has been in successful operation for more than two years.

In the opinion of CONCRETE the Council on Trade Agreements could perform a more useful service by showing individual groups how the principles underlying *Appalachian Coals* could be shaped to fit other industries. Inasmuch as this coal group already enjoys the sanction of the Supreme Court, trade agreements built on its pattern would stand on solid ground.

It is to be hoped that the various branches of the concrete construction and cement manufacturing groups will have the vision to work out their salvation in this manner.

Small Fireproof Buildings

Once more, through the channel of actual bids, it has been demonstrated that small buildings can be built fireproof at a cost no greater than the cost of wood frame construction. This is true not only of structures such as single-family dwellings, and small school and church buildings, but it is equally true when applied to even smaller buildings, including gasoline filling stations, lake cottages, roadside tourist cottages, private garages, and so on.

In this issue a new method of fireproof construction is described, in the article headed *Fireproof Buildings Below Cost of Wood Frame.* The method is, as a matter of fact, not new, for both the materials and the construction methods employed are well known to building contractors. It is the *combination* of materials and methods that is new.

Here is an unusual chance for any enterprising local contractor to get into a class by himself—as the local fireproof construction man. With the knowledge and promotional experience of a national manufacturers' association back of him, a wide-awake local builder can soon develop the construction technique required for this type of work, at the same time determining his costs.

The type of construction described and illustrated in this article is not the only type of fireproof construction that can be built at a cost equal to, or below, the cost of wood frame construction; but this type, in addition to being fireproof, has the additional merit of being rigid and monolithic, and therefore proof against storm and earthquake.

CONCRETE will be glad to place reader-contractors into touch with the people who can help them get started in this great field.

Broader Markets for Products

Concrete products plants in Detroit are working seven days a week. Many eastern concrete products plants are on full-time production for the first time in years. These heartening and almost breath-taking facts are taken from the *News Letter* of D. R. Collins, assistant secretary of the National Concrete Masonry Association, in this issue of CONCRETE.

In a word, the concrete products industry is well along on the road to recovery. The revival in private home construction is in considerable part responsible for this definite improvement; but home building is not the only cause. Added gains have been made because concrete building units are gaining favor in the eyes of architects and specification writers.

Federal specifications have been modified to permit the use of concrete units in new government buildings. Slum clearance and subsistence homestead projects have utilized concrete products, and will utilize many more. The Federal Housing Administration has issued an official ruling accepting precast reinforced concrete joists as a standard type of construction, acceptable for insured loans.

The concrete masonry industry is gaining ground because its products are being accepted over a broader scope—for purposes that were scarcely dreamed of a decade ago.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Arsenic Admixture in Concrete Protects Wooden Piles

A process has been developed in Sweden for the protection of wooden piles in sea water (as in piers and harbor work), in which concrete mixed with an unstated quantity of arsenic is used for coating the piles.

The admixture of arsenic helps the cement to adhere to the wood and confers sufficient elasticity to prevent the cement coating from spalling off. Portland cement and sand in the proportions of 1:4 are mixed dry with the arsenic salt, and conveyed through a hose to the point where a pile is to be treated. Water is added near the nozzle, and the mixture is immediately blown on to the piles with a double nozzle. The coating hardens in 15 minutes to the extent of permitting the piles to be handled without injury to the coating.

The operators work from a barge, so that the part of the mixture which does not stick drops into the water and does not spread. Masks and gloves are worn by the operators.

It is said that arsenious oxide (As_2O_3) is the form in which the arsenic salt is used in this work.—From *The Chemical Age* (England), June 1, 1935.

Maryland's Highway Program Planned in Advance

TEN-YEAR HIGHWAY CONSTRUCTION PROGRAM FOR MARYLAND is the title of a comprehensive 48-page mimeographed report dated April, 1935, prepared by the subcommittee on highways of the State Planning Commission, and published through the courtesy of the Maryland State Roads Commission, of which Nathan L. Smith is chairman.

The report is illustrated by maps and charts, in addition to the 48 pages of text and tabulations. The report deals with the important subject of advance planning of highways, and presents a program of proposed construction for the coming 10-year period, including improvement of existing routes, construction of new routes, and construction of railroad grade-crossing elimination structures. A full section is devoted to standards of design.

Harry D. Williar, Jr., chief engineer of the Maryland State Roads Commission, Calvert and Lexington Streets, Baltimore, Md., was chairman of the subcommittee that prepared this report.

Distortion of Concrete Pavement Slabs

C. P. OWENS, chairman of the maintenance department of the Highway Research Board (2101 Constitution Ave., Washington, D. C.), reports in the July (1935) issue of *Highway Research Abstracts* the preliminary findings of the project committee on warping of concrete pavement slabs. This committee was organized in January, 1935, to study the distortion of concrete pavement slabs, its causes, and means of prevention. The Committee has summarized the indications to date as follows:

1. High joints, resulting from warping or curling of slabs on each side of a joint or crack, are definitely related to the type and character of the subsoil, and also to its moisture condition and compactness at the time of concreting.
2. Major distortions are caused by heaving of the subgrade, which in turn is due to unequal moisture distribution.
3. Curling of the slab, in itself, is not sufficient to cause excessively high joints.
4. There is some evidence that the high joints may be prevented on new construction by subgrade treatment, design or maintenance to prevent entrance of water, or by replacement of poor subgrade soil with good soil.
5. Pavements having high joints may be restored to proper profile by mud jacking, or possibly by introducing water to equalize the moisture in the subgrade.

The committee expects to continue the study by laboratory and field work during 1935. Members of the committee, besides chairman Owens, include A. A. Anderson, H. Allen, F. C. Lang, Henry C. Porter, C. S. Pope, and T. F. Willis.

Axle-Steel Reinforcement

PROPOSED tentative specifications for axle-steel reinforcement for concrete has been prepared by Subcommittee V of Committee A-1 on Steel, of the American Society for Testing Materials.

This proposed tentative specification was written at the request of the Axle-Steel Manufacturers' Association. The full text as submitted to the thirty-eighth annual meeting of the A.S.T.M. will be found in A.S.T.M. 1935 *Preprint No.* 7, comprising the full report of Committee A-1 on Steel. H. H. Morgan is chairman of the subcommittee that prepared the new specification.

Fabricated Reinforcement for Concrete

SUBCOMMITTEE V, of the American Society for Testing Materials Committee A-1 on Steel, is preparing a specification covering fabricated reinforcement for concrete, such as welded fabric, bar mats, and expanded metal. The chairman of Subcommittee V is H. H. Morgan.

More detailed information may be obtained from the American Society for Testing Materials, 260 So. Broad St., Philadelphia.

Index of Research Papers

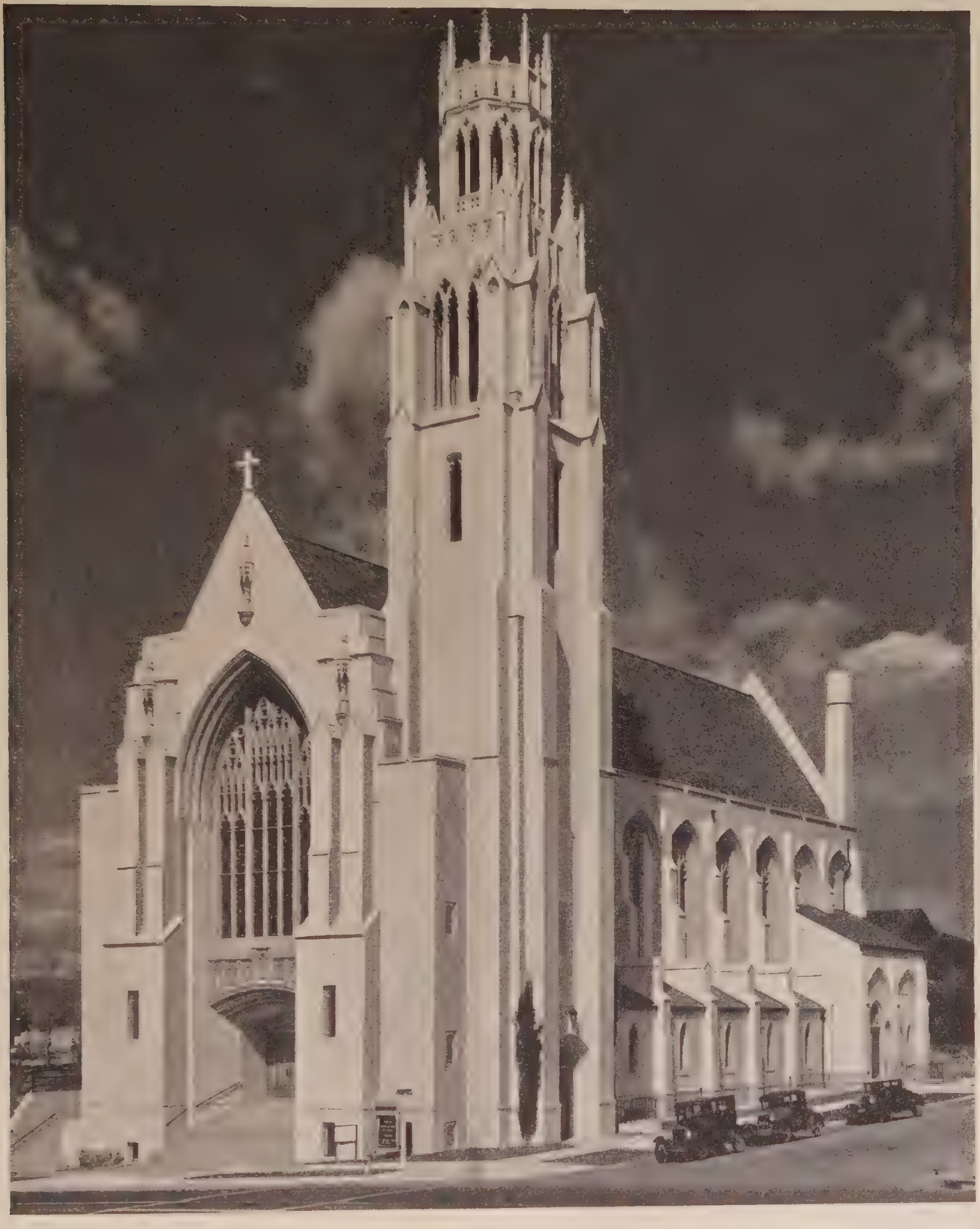
THE National Bureau of Standards, Lyman J. Briggs, director, has issued an 8-page index of Research Papers RP-691 to RP-752, published in Vol. 13 of the *Journal of Research* from July to December, 1934.

Copies of the index may be obtained from the Government Printing Office, Washington, D. C.

Proceedings of H. R. A.

THE PROCEEDINGS of the fourteenth annual meeting of the Highway Research Board, 2101 Constitution Ave., Washington, D. C., will be available for distribution about August 15. The fourteenth annual was held in Washington last December.

Architectural Concrete



Barber and Kingsbury, *Architects*

Modern Gothic church architecture is expressed through the medium of monolithic concrete in this great structure—the McCarty Memorial Christian Church, of Los Angeles, donated by the late Dr. Isaac A. McCarty.

The form work for flat surfaces was made of 2 by 8 and 2 by 10-in. dressed lumber. All moldings and most of the ornamental work were cast in place, either in run wood molds or plaster waste molds. Window trim and certain applied ornament were precast and set in place in the form work, and the wall concrete was deposited back of them. Only the free-standing cast stone tracery mullions and muntins were set up separately.

Volume Changes
in Cement, Mortar and Concrete

Series of Tests Determines Coefficient of Expansion Due to Changes in Temperature

By S. L. MEYERS
Chief Chemist, Southwestern Portland Cement Co., El Paso, Texas

VOLUME changes due to moisture changes in neat cements, mortars, and concretes appear to have been extensively studied, while volume changes due to temperature changes have rarely received any studies. Those studies which have been made were generally limited in scope. This has caused concrete designing engineers generally to use the figure 0.0000055 per degree Fahr. for the thermal coefficient of concrete, regardless of the kind of concrete fabricated or the composition of the cement used. Lack of comprehensive experiments on this subject appear to be due to two main causes:

First, the magnitude of thermal volume changes is considerably less than those volume changes due to moisture changes.

Second, suitable apparatus is not generally available for making thermal coefficient of expansion tests on cement or its products.

Some of the more important investigations on thermal volume changes are those by Pence,[1] Norton,[2] Mills,[3] Hatt[4] and Davis.[5]

Originally the present writer started the tests to be described here with the object of finding out what chemical composition of cement corresponded to a minimum of thermal dilation. So many unexpected results were obtained that in an attempt to understand the causes of the unexpected results, the effects of different conditions and length of time of storage have been investigated.

Excluding Other Influences

In order to measure volume changes due to temperature alone, volume changes due to loss or gain of moisture have been eliminated by sealing the test specimen in an air-tight container of very thin copper foil, which did not restrain the movement of the test piece. Before using the copper foil many other substances were tried, such as paints, waxes, shellac and rubber membranes, but none of these completely sealed the pores of the test pieces. Some moisture was almost always lost during test, and this raised the question of whether or not all of the linear changes of specimens under test were due to thermal changes of length or to a combination of thermal and moisture changes.

At first an attempt was made to regulate the humidity of the air surrounding the test bars, during the testing period, so that no moisture was taken up or lost; but to fulfill this condition each test bar required an atmosphere of different relative humidity, and the same test bar required a different moisture condition at different ages, so that the attainment of an ideal atmosphere in which the test bar neither gained nor lost moisture (shown by change of weight) was very difficult and required too much labor.

The test bars used were 1 in. square and 13½ in. long. They were sealed within the copper foil covering by means of solder. After soldering, each bar is tested for leaks by blowing air into the copper envelope while the bar is immersed under water. Some investigators have even reported negative coefficients for some neat cements. In such cases, no doubt, the contraction of a moist, unprotected neat specimen, due to moisture loss, was greater than the expansion due to heating while under test. A seasoned air-dried concrete of large mass will not be affected by moisture changes during a short period of test to as great an extent as a smaller specimen of neat cement.

The writer feels that the use of impermeable metallic covering has not

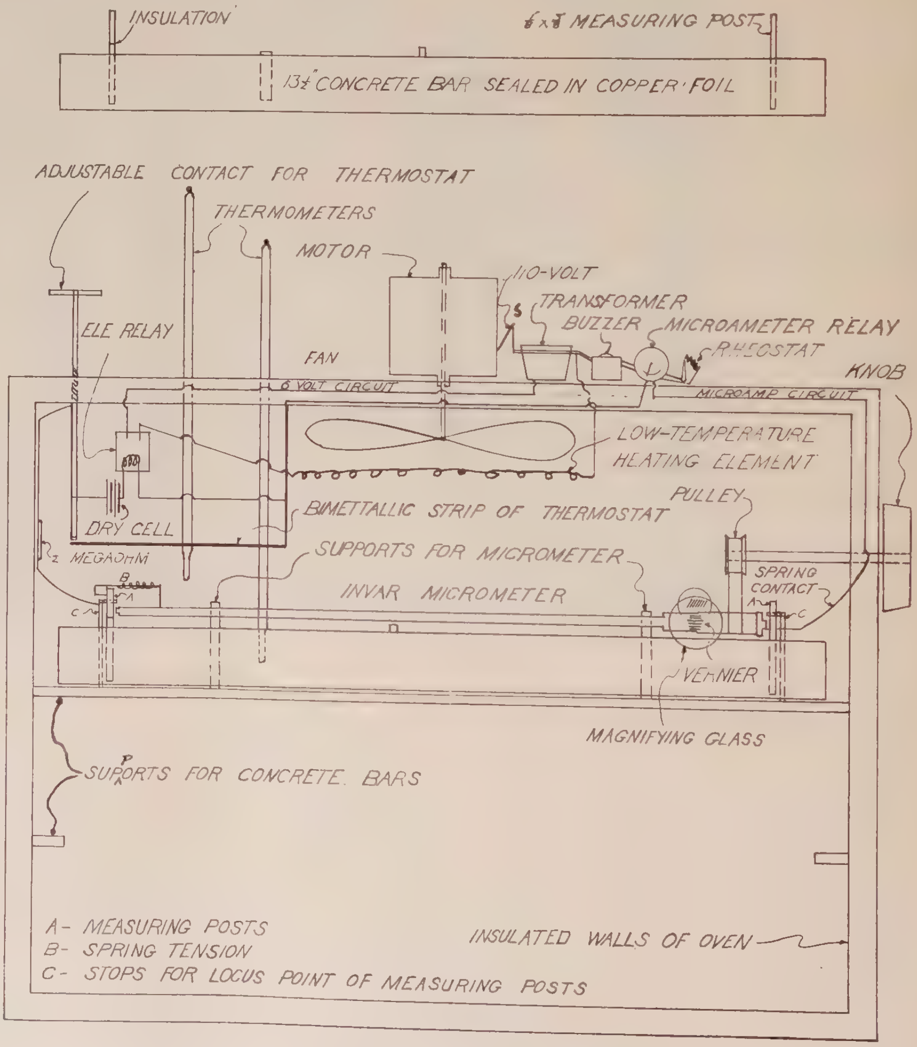


Fig. 1—Sketch illustrating apparatus and type of specimens employed in tests

completely solved the problem of moisture change effects, since the test pieces have some pore space into which a small amount of water vapor can escape upon heating and return to the solid of the test piece upon cooling.

Apparatus Used

The accompanying sketch illustrates the type of specimen and apparatus used. Means are shown for controlling temperatures of test pieces while under test.

An invar micrometer measures the change of length between two brass posts placed vertically in the test bar with their inner faces 12 in. apart, two brass measuring posts are clamped to the opposite and machined ends of a 12-in. spacing bar, the projecting ends of the brass posts are placed in the wet concrete, or neat cement, contained in forms 1 in. square and 13½ in. long; after the concrete has hardened the forms and spacing bars are removed, the copper foil sealed on and the inner, or measuring, faces of the brass posts highly polished. The test bars are kept in the same position by means of stops, and the polished faces of the brass measuring posts are always perpendicular to the plane of the micrometer, and the micrometer always contacts the same spot on the brass face. When the micrometer makes contact an electrical circuit is completed, causing a microammeter relay to ring a buzzer in a secondary circuit.

A small error is introduced by the expansion and contraction of the brass measuring posts, unless the coefficient of brass is identical with that of the specimen. Also if the specimen is not homogeneous at the point where the brass posts are cast the perpendicular plane of the brass faces may become distorted and introduce errors.

Before making the micrometer, the invar was analyzed and found to contain 35.56 per cent nickel, and the remainder was practically all iron. This material was sent to Brown & Sharpe, who constructed the micrometer. We calibrated our micrometer for a thermal expansion correction by the use of a microscope, watching the movement of one end of the micrometer, over a glass slide ruled in microns, during changes of temperature. Another check was the use of a fused quartz bar for a standard. It was found that the invar micrometer had a coefficient of 0.00000046 greater than the fused quartz. Assuming 0.00000022 as the coefficient of fused quartz for our range of temperature, we get 0.00000068 for the coefficient of the invar. Bureau of Standards Circular 58, Page 86, gives the coefficient of invar containing 35.6 per cent nickel as $(0.877 + 0.00127t)\ 10^{-6}$ per deg. C.

A correction of 0.0000006 per degree Fahr. has been used on all linear coefficients of cement and concrete specimens. Guillaume has shown that the invar coefficients of thermal expansion vary with the kind of heat treatment and working the metal receives. After heating for long periods it will show elongations of several microns per meter. Apparently this elongation was too small for our apparatus to detect, since the standard quartz bar continued to give constant-length measurements at a standard temperature throughout the tests.

Range of Temperatures

The invar micrometer can only be read to the nearest 0.0001 of an inch, or 0.0000083 variation for a 12-in. length; and if the range of temperature used is 50 deg. Fahr. the coefficient will be affected by 0.00000017, at least, due to errors in reading the micrometer alone. Most errors have been greatly reduced by increasing the number of determinations on a single test piece and taking the average of results. In most cases at least ten determinations were made on a single test piece. In a few cases duplicate specimens were made of the same material; and while the results were not always identical, they were reasonably close to each other.

Most of the length-change tests were made between 70 and 120 deg. Fahr. No convenient means was available for cooling the test pieces below 70 deg. Fahr. during the entire year. A few measurements were made between 40 and 90 deg. Fahr. when weather conditions permitted. The bars showed practically the same coefficient through this lower range as through the upper range. Possibly more delicate means of measurement might disclose some differences between different temperature ranges.

Higher temperatures than 120 deg. Fahr. were not used, for the following reasons:

(1) Temperatures higher than this are not very common where concrete is used.

(2) Hydration is speeded up at higher temperatures, and the test pieces might not perform identically as a test piece undergoing normal hydration.

(3) The vapor pressure of the test piece is increased at higher temperatures, making it more difficult to insure that there will be no loss of moisture while testing.

The specimens were first measured at 70 deg. Fahr., heated to 120 deg. Fahr. and measured after allowing sufficient time to elapse for the specimens to come into thermal equilibrium with their surroundings. Then they were cooled to 70 deg. Fahr. and again measured. Changes of length were measured about equally between expansions on heating and contractions on cooling.

If consecutive measurements, with an intervening time interval, at a common temperature did not agree, tests were repeated on the specimen to be sure that it was not an error of measurement but an actual change of length of the specimen, independent of temperature.

Where tests followed each other within a day or two, there was seldom any change of length of the specimen; when several weeks elapsed between the tests the specimen frequently showed a change of length at the same temperature.

Test bars stored in water (water placed between test bar and copper foil) showed a very small, but continuous increase of length. Test bars stored in air, or where the moisture could be absorbed by hydration with no access of fresh moisture, or where leaks in the copper foil allowed moisture to escape, showed a continuous decrease of length with time at the same temperature.

Where bars have been steamed, expansions generally occurred, particularly with high-lime cements. In a few instances very low-lime cements showed contractions due to steaming.

The Test Specimens

In making concrete test pieces the size of the bar necessarily limited the maximum size of aggregate that could be used, so a graded aggregate from ½ in. to 100-mesh size having a fineness modulus of 4.01 was used. The same absolute volume of aggregate and cement, obtained by weighing after correcting for specific gravity, and the same quantity of water, corrected for absorption, were used for each concrete, except where one of these conditions was intentionally varied. The concrete was placed in molds by vibration; then stored in the moist room at

70 deg. Fahr. until hard enough to safely handle (1 to 3 days) and covered with copper foil. Thermal expansion tests were run on the bars at intervals from this time until the age of nine months. The coefficients given in the tables are the average coefficients found for the whole period.

TABLE 1—EFFECT OF DIFFERENT KINDS OF AGGREGATE ON THE THERMAL COEFFICIENT OF CONCRETE

Mix 1:4.7 by volume, fineness modulus 4.01, consistency about equivalent to a 1-in. slump

Bar No.	Aggregate	Coefficient
20	Fine limestone	0.0000050
51	Coarse limestone*	.0000048
28	Dolomite	.0000058
32	Granite	.0000049
76	Basalt	.0000051
27	Flint	.0000074
31	Sand	.0000063
35	Cinders	.0000044

*Fineness modulus 5.5, mix 1:5.

TABLE 2—EFFECT OF RICHNESS OF MIX IN SAND MORTARS

Bar No.	Mix	Coefficient
19	Neat standard cement	0.0000102
42	1 cement : 1 sand*	.0000074
43	1 cement : 3 sand	.0000062
44	1 cement : 6 sand	.0000058

*Siliceous river sand, fineness modulus 3.1, mixed to a stiff, but workable, consistency.

As the proportion of sand increases the coefficient decreases.

TARLE 3—EFFECT OF WET AND DRY STORAGE

Bar No.	Storage condition	Coefficient
37 D	Limestone concrete, sealed with no addition of water after making	0.0000037
37 W	Limestone concrete, sealed but containing free water within seal	.0000028
38 D	Dolomite concrete, sealed with no addition of water after making	.0000053
38 W	Dolomite concrete, sealed but containing free water within seal	.0000050

TABLE 4—CHANGE OF COEFFICIENT WITH TIME

Bar No.	Description	Age at test 3 days	1 week	1 month	6 months	9 months
19	Standard neat	0.0000072	0.0000079	0.0000103	0.0000108	0.0000118
24	Limestone concrete	.0000044	.0000046	.0000052	.0000056	.0000057
11	High-silica cement, neat	.0000066	.0000068	.0000081	.0000099	.0000099
56	High-lime cement, neat	.0000101	.0000103	.0000106	.0000107	

This increase of coefficient with time appears to be associated with the moisture condition of the bar, and not to the formation of new hydrated compounds, as Table 5 shows.

TABLE 5

Bar No.	Description	Coefficient at 9 months, air-sealed covers	Coefficient at 9 months plus 1 week (after soaking same bars in water 1 week)
23	Lime masonry cement	0.0000104	0.0000053
High w/c 26	Limestone concrete	.0000031	.0000031
27	Flint concrete	.0000081	.0000049
42	1 cement; 1 sand mortar	.0000092	.0000063
83	High tricalcium silicate, neat	.0000114	.0000056

Effects of Moisture

The presence of free moisture affects the thermal coefficient to a great extent. The drying out of test bars in air storage over a long period of time, in spite of being sealed in copper foil, may be due to two causes. First, it may be due to small leaks in the copper coating due to abrasions of the thin foil. At times all bars were tested for air leaks before making thermal measurements, and many had to have leaky foils repaired. During hydration up to one year, different cement compounds require from 12 to 40 per cent of water for chemical combination.[6] This diminishes the free water present.

Some water is also taken up as adsorbed, or surface-held water. White[7] has shown that capillary-entrained water in concrete can not be frozen. That is, the capillary forces are greater than the crystalline forces. More recently, Powers[8] has shown that water is taken up by a cement-water paste without a corresponding increase of volume, indicating that the water is adsorbed to cement surfaces with sufficient force to compress the adsorbed water and diminish its bulk. (Also, the hydrated products could have a greater density than the original physical mixture).

The structure of concrete, and more particularly neat cement, contains a network of capillaries. In the tiny capillaries enormous tensions are developed by moisture on the walls of the tiny pores. Freyssinet has attempted to show that these capillary tensions correlate the phenomena of plastic flow, shrinkage and thermal expansion. He has further shown that there is a direct relation between capillary diameters, the hygrometric state of the air and the tension exerted by the capillaries. If this is true one would expect different physical behavior from a cement test piece, depending upon its hygrometric state.

The accompanying graph shows that, with a few exceptions, the coefficient increases with tricalcium silicate content about as uniformly as could be expect-

TABLE 6—EFFECT OF COMPOSITION ON THERMAL EXPANSION

Bar No.	Passing 200-mesh sieve	Per cent water, N.C.*	Composition	Tetracalcium Alumino-Ferrite	Tricalcium Aluminate	Dicalcium Silicate	Tricalcium Silicate	Coefficient
1	98.6	44.4	Gamma dicalcium silicate	—	—	98.0	—	0.0000052
2	98.8	43.0	High tricalcium aluminate	4.13	32.10	—	57.75	.0000068
4	98.0	25.0	Tetracalcium alumino-ferrite	99.0	—	—	—	.0000063
5	92.1	23.7	Standard cement	8.80	9.20	15.0	58.0	.0000093
11	94.6	24.0	High-silica cement	5.65	5.58	46.85	34.86	.0000078
13	99.5	26.0	High-early-strength cement	10.50	12.00	3.60	66.23	.0000108
14	95.4	26.0	White cement	1.40	12.50	41.50	33.00	.0000104
21	99.0	25.2	High iron, high tricalcium silicate	18.24	3.83	6.49	68.79	.0000092
56	94.2	24.0	Low tricalcium aluminate and tetracalcium alumino-ferrite	6.54	4.05	21.70	58.62	.0000106
57	94.0	22.8	Low tricalcium silicate	5.53	3.49	54.51	28.89	.0000073
60	N D	24.0	High tricalcium silicate	7.97	8.81	5.75	69.34	.0000116
63	93.8	21.5	High silica, low R_2O_3	5.17	3.68	50.75	33.25	.0000097
62	94.0	24.0	Very high tricalcium silicate	7.90	8.89	4.17	70.62	.0000118
93	95.4	26.0	High tricalcium aluminate and tetracalcium alumino-ferrite; low tricalcium silicate	22.71	14.54	56.00	0.0	.0000054

*Neat bars mixed to normal consistency.

The thermal coefficient of expansion appears to increase in the following order: Dicalcium silicate, tricalcium aluminate, tetracalcium alumino-ferrite, tricalcium silicate, the last-named having more than twice the value of the first-named coefficient.

ed, considering that during most of this test period it was not appreciated that different moisture conditions altered the thermal coefficient, and no definite attempt was made to keep a constant moisture condition of the bar, except during test measurements and bars stored in water. No doubt more accurate information could be obtained with future tests under more rigid moisture control.

TABLE 7—EFFECT OF W/C RATIO AND VOID SPACES ON THE COEFFICIENT OF NEAT CEMENT AND CONCRETE BARS

Bar No.		W/C Ratio	Coefficient
8	20 per cent water, neat	0.30	0.0000095
5	25 per cent water, neat	.37	.0000093
9	40 per cent water, neat	.60	.0000103
82	50 per cent water,* neat	.75	.0000083
24	Limestone concrete, rich mix	.75	.0000049
33	Limestone concrete, medium mix	.85	.0000043
25	Limestone concrete, lean mix	1.50	.0000033
35	Cinder concrete (very porous and light)		.0000044
54	Neat cement, expanded by hydrogen		.0000060

*In neat cement mixtures some water separates on standing when the weight of water to cement becomes greater than 40 per cent. Separated water not effective.

Here the effect of the water-cement ratio on neat bars is far from clearly indicating anything. Its effect on concrete is apparently consistent, but the kind of mix used is also a factor. Since the presence of water decreases the coefficient, the effect of increasing w/c may be due to the presence of excess water beyond that needed for hydration of the cement.

TABLE 9—EFFECT OF DEGREE OF BURNING AND CONDITION OF COOLING CLINKER

Bar No.	Condition	Coefficient
80	Under-burned clinker (free lime 2.31)	0.0000109
49	Hard-burned clinker (1)	.0000103
50	Hard-burned clinker (2)	.0000125
65	Clinker slowly air-cooled	.0000126
66	Clinker rapidly air-cooled	.0000124
67	Clinker rapidly water-cooled	.0000127
72	Cement from fine clinker	.0000126
73	Cement from coarse clinker	.0000119

The above factors appear to play such a small part that it is possible that such differences that do appear are mainly due to variation in composition and partly to inaccuracies of testing.

TABLE 10—EFFECT OF FINENESS

Bar No.	Condition	Per Cent of Fines between 0-20 Micron Sizes	Coefficient
34	Concrete using clinker as aggregate	7.6	0.0000056
5	Coarse-ground cement	26.0	.0000089
19	Medium fine cement	46.6	.0000102
18	All-flour cement	100.00	.0000101

In general, the coefficient appears to increase with fineness.

TABLE 8—THERMAL COEFFICIENT OF EXPANSION OF MASONRY CEMENTS

Bar No.	Per Cent of Water to Weight of Cement	Composition	Coefficient
12	28.0	37 per cent portland cement, 59 per cent limestone, 4 per cent bentonite	0.0000066
23	33.0	40 per cent portland cement, 60 per cent hydrated lime	.0000072
85	34.0	33 per cent portland cement, 67 per cent hydrated lime	.0000072
39	31.5	60 per cent portland cement, 30 per cent limestone, 10 per cent diatomaceous earth	.0000056
40	31.5	60 per cent portland cement, 32 per cent limestone, 8 per cent diatomaceous earth	.0000056
48	32.0	80 per cent portland cement, 20 per cent siliceous tufa	.0000104
55	30.0	White natural cement	.0000060
87	37.2	36 per cent portland cement, 25 per cent sand, 35 per cent hydrated lime	.0000085

Since most of the materials blended in with portland cement to make masonry cement have a lower coefficient than portland cement, the resulting product has a lower coefficient. Another factor which might affect the coefficient is the greater void spaces present in this type of cement and the greater w/c ratio needed. In tests on concrete bars it has been noted that an increase of void spaces or an increase of w/c lowers the thermal coefficient.

TABLE 12—EFFECT OF VARYING MOISTURE TREATMENT

Bar No.	Coefficient at 9 months	9 mo. usual storage, then steamed 24 hrs. at 205 deg. F.* Coeff. after steaming	9 mo. usual storage, then water storage for one week	9 mo. usual storage, then steam or water storage, then dried over $CaCl_2$ for one week
g. (neat)	0.0000123	0.0000027 (second steaming)	————	0.0000082
16 (neat)	————	.0000065	————	.0000076
47 (neat)	.0000125	————	0.0000069	.0000109
59 (neat)	.0000112	.0000059	.0000059**	.0000088
24 (concrete)	.0000056	————	.0000043	.0000044

*Boiling point at altitude of test.

**Nine months usual storage, steam treatment, then water storage of one week.

Rapid drying alone does not increase the coefficient to the same degree as the combination of age and dryness. A possible explanation of this is that the outer layers of the neat bar act as a difficultly permeable membrane; the flow of water through tiny capillaries is slow and requires long periods of time to be very effective.

Concrete, being composed mainly of inert aggregate, is not affected by wet or dry condition of storage nearly so much as neat cements, the latter possessing the properties of a glue-like colloid.

Here again, as was indicated in Table 11, steam treatment has greatly lowered the coefficient.

TABLE 11—EFFECT OF TEMPERATURE OF STORAGE

Bar No.	Condition	Coefficient
68	Two weeks at 40 deg. Fahr.	0.0000090
19	Standard, stored at 70 deg. Fahr.	.0000104
70	One week, at 120 deg. Fahr. (moist)	.0000100
69	One week, at 205 deg. Fahr.* (moist)	.0000068
71	Three weeks, in steam at 500 deg. Fahr. and 200 lb. pressure	.0000064

*Boiling point at altitude of test.

Results of Tables 3, 4 and 5 indicate that the decrease of the coefficient may be due to a moist physical condition rather than a speeding up of the reactions of hydration.

Possibly steaming lowers the coefficient of cements containing tricalcium silicate by hastening the formation of dicalcium silicate and calcium hydroxide, both having lower coefficients; but this must be less important than moisture conditions, since the above chemical reactions occur during aging, yet the coefficient increases with age unless the test bars are kept moist.

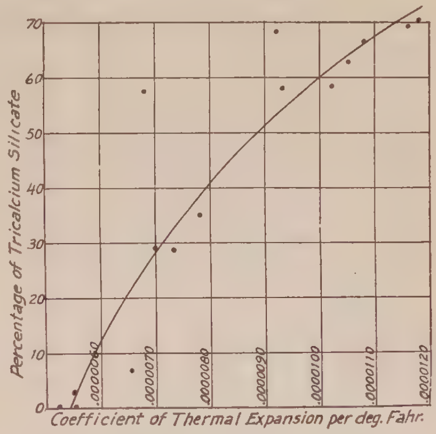


Fig. 2—Thermal coefficient increases with increase in tricalcium silicate content

TABLE 13—EFFECT OF GYPSUM IN PORTLAND CEMENT ON THE THERMAL COEFFICIENT

Bar No.	Condition	Coefficient
19	Standard cement containing 3½ per cent gypsum	0.0000102
7	Standard cement containing 6½ per cent gypsum	.0000102
77	Finely-ground clinker without gypsum	.0000109
78	Finely-ground clinker plus 3 per cent gypsum	.0000109
79	Finely-ground clinker plus 6 per cent gypsum	.0000110

Any effect gypsum might have was too small for this method to detect.

TABLE 14—EFFECT OF CALCIUM CHLORIDE ON THE THERMAL COEFFICIENT

Bar No.	Condition	Coefficient
19	Standard cement	.0000102
81	Standard cement plus 2 per cent $CaCl_2$	.0000121
52	Standard cement plus 4 per cent $CaCl_2$	.0000130
64	Plastic cement containing $CaCl_2$	.0000128

Here the effect of calcium chloride might be due to a quicker combination of chemical water, or a better retention of adsorbed water, with a consequent lowering of free moisture.

There is also the possibility of the formation of chloride containing compounds with higher coefficients.

Summary

(1) The thermal coefficient of expansion of concrete increases with richness of mix, and varies with the kind of aggregate used and the condition of storage. Where drying out occurs it increases with age. Where moisture prevails the coefficient does not increase with time.

(2) The coefficient of neat cements varies with the chemical composition, being highest in cements high in tricalcium silicate, and low in cements containing a high percentage of dicalcium silicate. Iron and alumina compounds occupy an intermediate position.

(3) The coefficient is decreased by steam treatment, and, in the case of neat cements, by water storage following dry storage. Concrete is affected to a lesser extent.

(4) The quantity of gypsum present in the cement, within the limits used, has no effect on the coefficient.

(5) The manner of clinker cooling has little effect on the coefficient.

(6) All masonry cements tested had a lower coefficient than straight normal portland cement.

(7) The coefficient generally decreases with an increase of the water-cement ratio.

References:

(1) "Coefficient of Expansion of Concrete" Jl. Western Soc. Engr. Vol. 6, Page 549, 1901.

(2) Eng. News, Page 711, Dec. 29, 1910.

(3) Hool and Johnson's Concrete Engineers' Handbook.

(4) "Effect of Moisture on Concrete" Trans. Am. Soc. C. E. Vol. 89, Page 270, 1926.

(5) Volume Changes in Concrete" Jl. A.C.I. Feb., 1930.

(6) Ind. & Eng. Chem., Vol. 26, Page 837, Aug., 1934.

(7) Colloid Symposium Monograph, Vol. V, Page 349.

(8) Research paper from P.C.A. Lab. "The Absorption of Water by Portland Cement Paste During the Process of Hardening."

Making Compression Tests of Concrete

COMMITTEE C-9 on Concrete and Concrete Aggregates, of the American Society for Testing Materials presented a 37-page report at the annual meeting of the Society, held in Detroit the last week in June, among which was a proposed *Tentative Method of Making Compression Tests of Concrete, Using Portions of Beams Broken in Flexure.* The decision at the convention was to publish the proposed specification as a tentative standard. The text of this new tentative standard follows:

Scope

1. This method is intended to cover compression tests of concrete, using for the test specimens portions of beams broken in flexure in accordance with the *Tentative Laboratory Method of Making Flexure Tests of Concrete, Using a Simple Beam with Center Loading* (A.S.T.M. Designation: C 78—30 T) of the American Society for Testing Materials,[1] or portions of beams having a square cross-section molded and tested in accordance with other recognized methods.

Size and Shape of Specimen

2. The broken portions of beams selected for the compression test shall have a length not less than 2 in. greater than the depth of the beam, and they shall be free from cracks, chipped surfaces, or other obvious defects.

Preparation of Test Specimen

3. If the sides of the beam as cast consist of plane, smooth surfaces, accurate to 0.005 in., no capping will be necessary. If the sides of the beam as cast are not true planes they shall be capped in such a manner that plane surfaces are secured on opposite sides of the beam as cast. The caps shall cover the full width of the beam and shall be of such length as to permit the adjustment of the bearing plates for the test so that the upper bearing plate may be placed directly over the lower bearing plate. The material used for capping and the thickness of the cap shall be such that it will not flow under the load.

Method of Testing

4. Only the ultimate compressive strength shall be determined. The specimen shall be tested between machined metal bearing plates not less than $\frac{3}{4}$ in. in thickness. The diameter of the spherical bearing block shall be at least 75 per cent of the depth of the beam. The dimension of the plates parallel to the length of the beam shall be equal to the nominal depth of the beam. The upper bearing plate shall be placed directly over the lower plate. A device insures the proper location of the upper plate with reference to the lower plate. The load shall be applied to the bearing blocks by means of an adjustable head.

Application of Load

5. The load shall be applied uniformly and without shock. The rate of application of load shall be not in excess of that applied by a testing machine, the moving head of which under no load travels at the rate of 0.05 in. per min.

Record of Test

6. The total load indicated by the testing machine at failure of the test specimen shall be recorded and the unit compressive strength calculated in pounds per square inch. In calculating the unit compressive strength, the cross-sectional area shall be taken as the average of the upper and lower contact areas. The type of failure and appearance of the concrete shall be noted.

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[1] *Proceedings,* Am. Soc. Testing Mats., Vol. 30, Part I, p. 1027 (1930); also 1934 Book of A.S.T.M. Tentative Standards, p. 474.

Insurance Rate Is Low

(*Continued from page* 11)

wisdom of choosing concrete as an architectural medium. All of the requirements demanded by the owner were met —economical construction, low upkeep, a design permitting plenty of light, and a pleasing appearance.

Insurance Rates Extremely Low

The extremely low insurance rates of $0.0575 per $100 demonstrates the fire-safe construction of the building. For material stored, a rate of $0.30 per $100 is effective, only half of which is for fire protection. This is believed to be the lowest rate of its kind in the country.

In addition to these advantages, the third floor, though added several years after the first two were built, matches the lower stories perfectly—a tribute to the art of properly controlled concrete mixes.

Acknowledgments: Bedford Brown, IV, was the architect. Pringle and Arnold were the structural engineers. The builder was Walter B. Avery, 632 G Street, N.W., Washington. Mr. Avery personally supervised the job.

BEGINNING on this page is the first of a series of *News Letters* which CONCRETE is enabled to present to the concrete products industry through the courtesy of D. R. Collins, assistant secretary of the National Concrete Masonry Association.

Mr. Collins, known to every man in the products industry by the more familiar appellation of "Spec," is at the fountain-head of information pertaining to this industry—an industry which clearly is feeling the thrill of new business activity.

Let us also add, once more, that the author of these *News Letters* claims no monopoly of these pages. Anyone who has in mind some matter of importance to the industry should feel free to write us about it. His name will not be used without his consent—the idea, after all, is the important thing.

Concrete Masonry Industry + News Letter +

Many Manufacturers Return to Full Production Basis —The New Markets

By **D. R. COLLINS**

Assistant Secretary, National Concrete Masonry Association, 33 W. Grand Ave., Chicago

WITH home building still leading the way in total value of new construction, renewed activity on the part of concrete products manufacturers has reached a gratifying stage. Sitting on the side-lines in Chicago, but in contact with manufacturers from all sections of the United States, it is heartening to hear that business is quickly creeping back to the point where it was in 1929-30, before it was almost totally abandoned.

A manufacturer from Detroit in the office a few days ago stated that plants in that vicinity were working seven days a week. Reports from the East indicate that many plants are on full-time production for the first time in years. Other reports indicate that not only has the home market provided a fertile field for products manufacturers, but many plus advantages of concrete masonry and the development of ashlar have provided extensive outlets which did not seem possible five years ago.

Particularly noticeable are the number of stories of concrete houses now being published in home and building magazines. Perhaps at no time in the history of its career has the concrete masonry industry been given as much worth-while publicity as during the last six months. Such high-grade magazines as *Better Homes & Gardens*, *American Home*, *House Beautiful*, *Delineator*, and others, are devoting considerable space to telling the story of the concrete masonry home. All of this publicity is creating a new conception of our product in the minds of the prospective builder, but it is up to us to cash in on this by actually clinching the jobs.

Another significant thing is that concrete masonry is being used in more demonstration homes this year than ever before. Every one of these demonstration homes will be seen by thousands of people, who, after seeing them, will realize that our material is certainly a suitable one for home construction.

Those of us who haven't followed through on the G-E demonstration houses certainly should do so. In one small area in Illinois, five G-E demonstration homes are being built, with concrete masonry as the basic construction material. Certainly the manufacturers in this area are going to cash in to a great extent, not only because of the people who see the homes, but because of the vast amount of national and local publicity which G-E is giving its homes.

If there is a G-E home proposed in your community and you haven't contacted the local representative, you surely should do so at once and see if you can possibly get your material specified for the walls and partitions of this house. G-E will continue to build these homes during the year. Twelve hundred is their objective. Not all of them are under construction yet, so there is still time to obtain a great deal of publicity from this source.

Government agencies are asking the Works Relief Administration for much money for such buildings as barracks, schools, training stations, post offices, court houses and other structures where our materials can be used. Follow every one of these projects. Your local Portland Cement Association office knows where they are as quickly as the allocation is made, and will be glad to assist you in following through.

Slum clearance and subsistence homestead projects should also be good markets for concrete products this year. A new ruling on the slum clearance projects, making possible a government grant of 45 per cent, and changing the amortization period to 60 years, gives new life to these projects in spite of constant litigation on the part of authorities negotiating for sites.

Under the Rural Rehabilitation Section, it is expected that between 50 and 60 new subsistence homestead projects will be brought out this year. You can determine in your own communities if such a project is to be located near you; then follow through with the local men in charge to see that your product is specified. Help will be given by the Association in this respect. Its representatives are watching every possible outlet to see that concrete masonry gets an even break with other materials in the specifications.

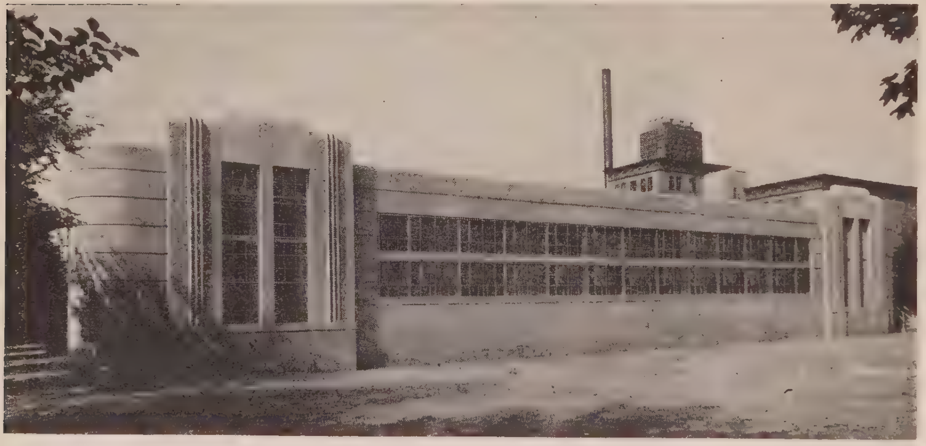
Many manufacturers seem to be finding a sizable market in garage construction. With more new cars on the road than in any year since 1929, there is a great shortage of garage space in many communities. Live products manufacturers have taken advantage of this situation and are selling much of their material to house this vast hoard of new automobiles. It's good business; something for you to think about and follow through.

Another market that has recently developed is that of movie theatres. Many old, small theatres in prosperous neighborhoods are being remodelled this year. When originally built, there was no such thing as sound pictures. In remodelling, sound has to be taken into consideration. Concrete ashlar units made of aggregates having a good acoustic value are the logical material for such construction. Much work of this kind has been done in Detroit. In fact, it is becoming standard construction in that city. The P. C. A. has just published a new book on concrete ashlar which is the finest thing of its kind ever printed. If you haven't received your copy, better get a sample. I am quite certain you will want to use a quantity of these books in selling prospective customers on the use of concrete ashlar.

During the past month, the Federal Housing Administration has issued an official ruling accepting precast joists as a standard type of construction, acceptable for insured loans—a good selling argument for the joist manufacturer and further opening the way for future sales of this material.

All in all, prospects look better at this writing than they have at any time during the last five years—in fact, better than when we were at the peak of construction. Home building is again on the up-grade, but we are no longer depending on that for the main volume of our business.

Colored Gravel Gives Beautiful Finish to Cast Stone



THE new bottling plant of the Rochester Brewing Co., Rochester, N. Y., provides a noteworthy illustration of the highly improved appearance of industrial buildings made possible by the use of cast stone.

A point of unusual interest is the nature of the aggregates employed — a gravel from a local deposit in glacial drift. The gravel in this deposit has a remarkable variety and mixture of colors, including black and white, red and black, pure white, bluish gray, buff and pink, and ordinary stone gray.

The surface of the cast stone was ground after hardening, a treatment that brought out a beauty of color and texture far beyond anything that would be expected from a casual examination of the gravel itself.

Price-Cutting Has Started in Milwaukee

Editor, CONCRETE: I was very much impressed with the ideas offered by Mr. Crabbs, Mr. Christensen, and others, in your July issue, concerning the "next move" for the products industry.

In my humble opinion, concrete products men must do something to guard their interests and hold the gains made in the last two years. Unless we do this, the industry will drift right back again into the old way of doing things. A few trouble-makers will start cutting prices, then the responsible manufacturers will have to follow to save themselves.

I know what I am talking about, because this very thing has started here in Milwaukee. Before the NRA was declared invalid we were all getting 18 cents for the 8 by 8 by 16-in. block. Now some block-makers are down to 14 cents, and unless pressure can be brought to bear, the rest of us will have to play the game in the same way—by cutting our own prices. — A Products Man, Milwaukee, Wis.

Plans Are Good but Action Is Needed

Editor CONCRETE: Some good ideas were expressed in the letters from the leaders of the concrete products industry, on page 19 of your July issue of CONCRETE.

But I hope you will pardon me for saying that little good will come from these ideas unless one of the plans suggested or hinted at is actually put into action. I think CONCRETE could give no better service to our industry than by keeping after our state and national associations, and helping them get the industry organized on a practical and workable basis. The plans suggested are good, but action is better.—A. T., Ohio.

Colored Concrete Flagstones for Terrace

The *Dispatch-Herald* (Erie, Pa.) and *Better Homes and Gardens* are conducting a 1935 Better Homes Contest. Participants are urged to plan their remodeling or new building to include the garden.

A terrace of colorful concrete flagstones laid in light-colored cement will harmonize with any style of home.

"What! No Graphs or Slide-Rules?"

REMEMBER the man who apologized for writing a 5-page letter because he didn't have time to write it in one? That explains this book—it tries to do a one-page job with a 5-page subject. It sums up good concrete practice, for the convenience of the concrete man on the job—without benefit of graphs or slide-rules . . . Yes, we've an axe to grind—but it's really your axe, too. Because this book also tells why 'Incor' 24-Hour Cement makes it easier to get good concrete—and get it at lower cost. 'Incor' combines with water 5 times as fast as ordinary cement. That means working strengths in 24 hours or less—watertight curing in 48 hours, instead of 10 days. 'Better Concrete' gives the facts—write for free copy. Address 'Incor' Cement, Room 2207, 342 Madison Ave., New York. 'Incor'* is made and sold by producers of Lone Star Cement, subsidiaries of International Cement Corporation, New York; also sold by other leading cement manufacturers. *Reg. U. S. Pat. Off.

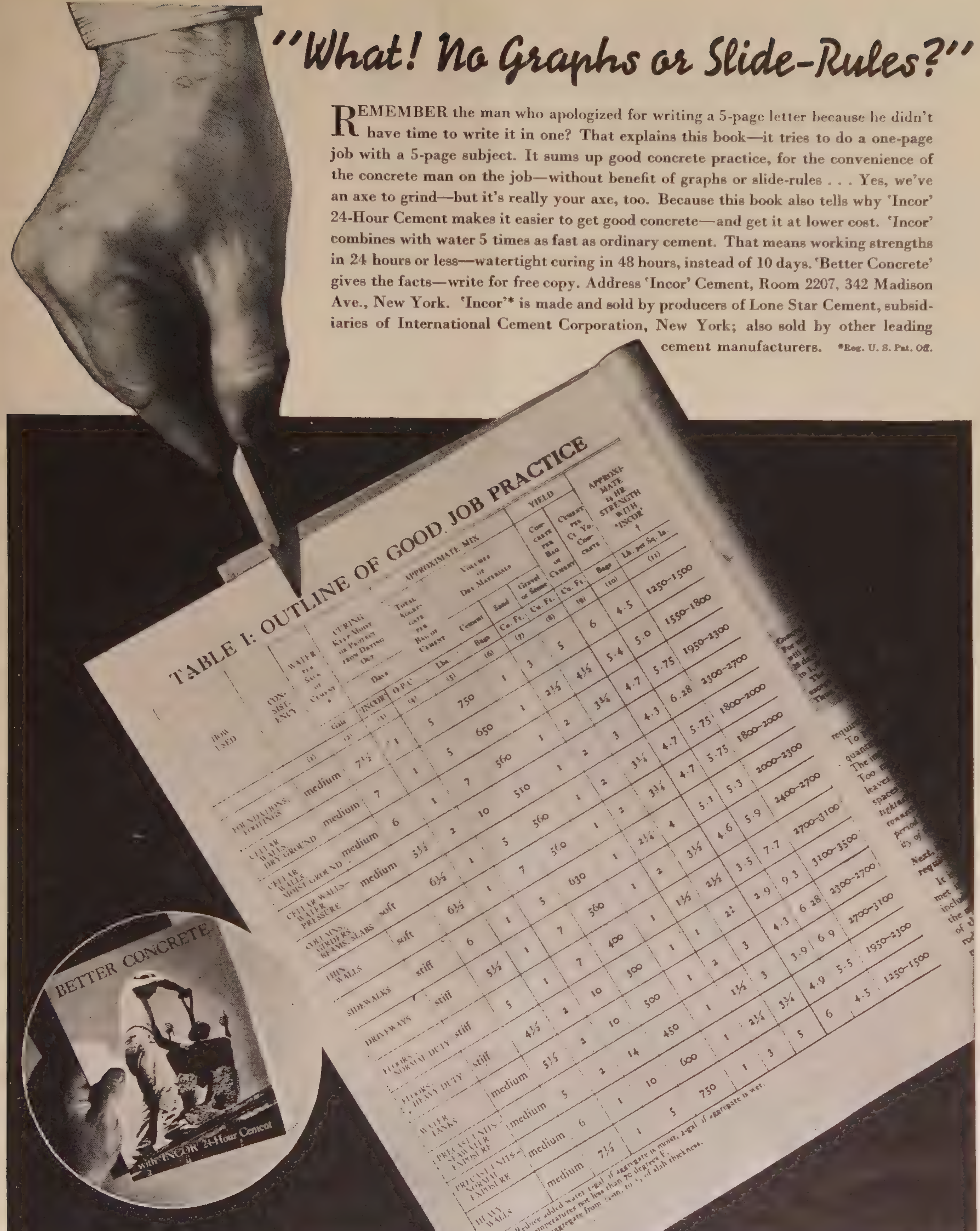


TABLE I: OUTLINE OF GOOD JOB PRACTICE

HOW USED (1)	CONSISTENCY	WATER PER SACK OF CEMENT* Gals. (2)	CURING: Keep Moist or Protect from Drying Out, Days: 'INCOR' (3)	CURING: Keep Moist or Protect from Drying Out, Days: O.P.C. (4)	APPROXIMATE MIX: Total Aggregate per Bag of Cement, Lbs. (5)	APPROXIMATE MIX: Volumes of Dry Materials: Cement, Bags (6)	APPROXIMATE MIX: Volumes of Dry Materials: Sand, Cu. Ft. (7)	APPROXIMATE MIX: Volumes of Dry Materials: Gravel or Stone, Cu. Ft. (8)	YIELD: Concrete per Bag of Cement, Cu. Ft. (9)	YIELD: Cement per Cu. Yd. Concrete, Bags (10)	APPROXIMATE 24 HR STRENGTH WITH 'INCOR' †, Lb. per Sq. In. (11)
FOUNDATIONS, FOOTINGS	medium	7½	1	5	750	1	3	5	6	4.5	1350-1500
CELLAR WALLS, DRY GROUND	medium	7	1	5	650	1	2½	4½	5.4	5.0	1550-1800
CELLAR WALLS, MOIST GROUND	medium	6	1	7	560	1	2	3¾	4.7	5.75	1950-2300
CELLAR WALLS—WATER PRESSURE	medium	5½	2	10	510	1	2	3	4.3	6.28	2300-2700
COLUMNS, GIRDERS, BEAMS, SLABS	soft	6½	1	5	560	1	2	3¼	4.7	5.75	1800-2000
THIN WALLS	soft	6½	1	7	560	1	2	3¼	4.7	5.75	1800-2000
SIDEWALKS	stiff	6	1	5	630	1	2¼	4	5.1	5.3	2000-2300
DRIVEWAYS	stiff	5½	1	7	560	1	2	3½	4.6	5.9	2400-2700
FLOORS—NORMAL DUTY	stiff	5	1	7	400	1	1½	2½	3.5	7.7	2700-3100
FLOORS—HEAVY DUTY	stiff	4½	2	10	300	1	1	2¼	2.9	9.3	3100-3500
WATER TANKS	medium	5½	3	10	500	1	2	3	4.3	6.28	2300-2700
PRECAST UNITS—SEAWATER EXPOSURE	medium	5	2	14	450	1	1½	3	3.9	6.9	2700-3100
PRECAST UNITS—NORMAL EXPOSURE	medium	6	1	10	600	1	2¼	3¼	4.9	5.5	1950-2300
HEAVY WALLS	medium	7½	1	5	750	1	3	5	6	4.5	1250-1500

(*) Reduce added water ½-gal. if aggregate is moist, 1-gal. if aggregate is wet.
† At temperatures not less than 70 degrees F.
(‡) Coarse aggregate from ¼-in. to ⅓ of slab thickness.

'INCOR' 24-Hour Cement

A.S.T.M. Studies Problems of Cement and Concrete

Annual Meeting at Detroit Hears Reports on Technological Phases of These Materials

THE fifteenth session of the recent annual meeting of the American Society for Testing Materials, held in Detroit, was assigned to the subjects of cement, lime and concrete.

High-Early-Strength Cement

Committee C-1 on Cement, in its preconvention report, had recommended the adoption as standard of the *Tentative Specifications for High-Early-Strength Portland Cement* (C 74—30 T). This recommendation was not approved at the meeting, and the specifications will continue as tentative. The Working Committee on Methods of Chemical Analysis gave a report including results of a preliminary study in analyzing several cements for magnesia by three quick methods. Since two of the methods were newer ones and not generally known, they were given in detail in the report. Twenty-four laboratories are co-operating in further investigations, and on the basis of data so far obtained there is a great likelihood that a very satisfactory quick method can be developed.

Concrete Pipe

Proposed *Specifications for Concrete Irrigation Pipe* will be published as tentative on the recommendation of Committee C-13 on Concrete Pipe. The committee also proposed the adoption as standard of the existing *Tentative Specifications Covering Non-Reinforced and Reinforced Concrete Sewer Pipe*, respectively. The Society will ballot on this recommendation during the summer.

Shrinkage

Based on an extensive series of tests, Professor R. W. Carlson, Massachusetts Institute of Technology, in his paper *The Chemistry and Physics of Concrete Shrinkage*, tentatively reported factors divided into major and minor groups which are believed to affect concrete shrinkage. Those having major influence, according to Professor Carlson's tentative list, are as follows:

(1) Amount and quality of gel in the hydrated cement; (2) amount of cement paste in the concrete; (3) surface character of the aggregate particles as regards the ability to entrain air; (4) depth of the concrete below an exposed surface (this factor probably varies with porosity); (5) size of concrete specimen (this factor also probably varies with porosity); (6) plastic flow of cement paste (controlled somewhat by strength of paste); (7) humidity to which concrete is exposed; (8) direction, as related to direction of moisture movement; (9) size of aggregate, mainly as it affects water content, voids, and number of surfaces of contact between paste and aggregate; (10) time of exposure to drying (determined by duration of dry season for service structures); and (11) porosity of aggregate.

Other Factors

Factors believed to have minor influence on concrete shrinkage are as follows: (1) rigidity of aggregate (within limits ordinarily encountered); (2) shape of aggregate particles; (3) chemical composition of aggregate (siliceous as compared with calcareous aggregates); (4) percentage of largest-size particles in aggregate; (5) gradation of aggregate, as it affects porosity and closeness of approach of particles.

In another paper on the "Shrinkage of Concrete" by Prof. Inge Lyse, Lehigh University, it was concluded that as a result of shrinkage observations made on a large number of 3 by 6-in. cylinders the quality of the paste showed little effect upon the shrinkage, while the quantity of the paste contributed approximately in proportion to its percentage of the volume of the concrete. The length of moist-curing had practically no effect upon the shrinkage. The high-early-strength portland cement produced more shrinkage than did the standard portland cement, particularly in lean mixes; but in terms of shrinkage per unit of strength, the high-early-strength cement proved superior. Fine aggregate showed more effect upon shrinkage than did coarse aggregate.

Concrete Aggregates

Committee C-9 on Concrete and Concrete Aggregates reported the development of three new proposed standards which will be published as tentative. The first of these is intended to cover compression tests of concrete, using as test specimens portions of beams broken in flexure in accordance with the *Tentative Laboratory Method of Making Flexure Tests of Concrete Using a Simple Beam with Center Loading* (A.S.T.M. Designation: C 78—30 T), or portions of beams having a square cross-section, molded and tested in accordance with other recognized methods.

A method of test for the determination of voids in coarse aggregate for concrete (dry rodded) was reported and also a method of test for determining the total quantity of material finer than a standard No. 200 (74-micron) A.S.T.M. sieve in aggregates.

Prof. R. E. Davis, University of California, in a paper appended to the report, described briefly various methods now in use for determining volume changes in plain concrete, indicating test conditions to be considered by the committee in formulating a standard method of test.

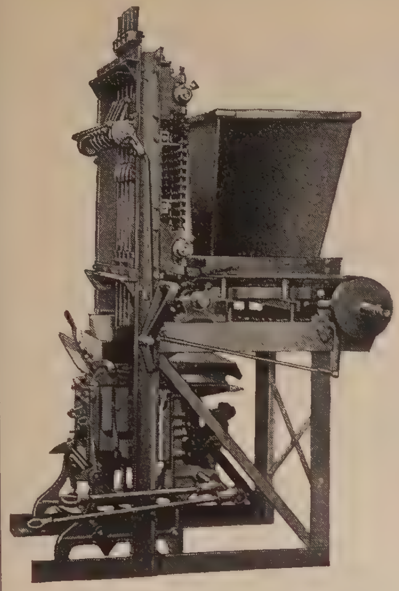
Study Disintegration

H. S. Mattimore and G. A. Rahn, Pennsylvania State Highway Dept., in their paper on *Research on Concrete Disintegration* presented the results of a research project undertaken to determine the cause of an abnormal rate of disintegration of concrete structures in northern Pennsylvania. The inspection record, with the available detailed data on quality of material, concrete proportioning, compressive strength, pH determinations on surrounding soils, and temperature records over a period of 4½ years, give information rarely, if ever, available on studies of field concrete.

The authors conclude that further study should be given the tetracalcium alumino-ferrite and alkali content in cements to be used in concrete subject to extreme exposure and rapid alterations of temperature, as these walls were.

Modulus of Elasticity

L. H. Koenitzer, Kansas State College of Agriculture and Applied Science, in a paper which is a continuation of work reported four years ago at the A.S.T.M. meeting, on *Determination of Modulus of Elasticity and Poisson's Ratio of Concrete at Ages of Fourteen Days to Four Years* indicated that the modulus of elasticity of plain concrete at the end of four years is about the same as at the age of fourteen days. Poisson's ratio for the mixes studied indicate a rapid increase for the first 56 days and then a gradual decrease until at the age of four years the ratio was in most cases equal to, or less than, Poisson's ratio at fourteen days. Aggregates have an important influence on the elastic properties of the resulting concrete, according to the author's conclusion.



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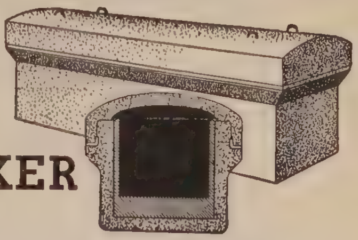

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A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

How Much Water with Cement Gun?

Your interesting and instructive article headed "Resurface Huge Industrial Building with Reinforced Gunite," appearing in the May issue of CONCRETE, *omits one important detail. How much water is used per bag of cement in this cement-gun work?—P. H. W., Philadelphia, Penna.*

The necessary quantity of water varies with different sands and varying moisture contents. As a general average, however, the quantity of water used is about 4½ gallons to the bag of cement. It should be understood, of course, that only a high quality of sand should be used—sand that is suitable for concrete work.

German Specifications for Pozzolanic Cements

Can you tell me where I can get copies of the German specifications for pozzolanic cements, and whether these specifications have been translated into English?

Presumably you are referring to the German specifications for trass cement. These are listed under the general heading "Bindemittel" (Cementing materials) on page 217 of *DIN Normblatt-Verzeichnis*, 1935 (*Index of Standard Specifications*, 1935), published by Deutscher Normenausschuss, Dorotheenstrasse 40, Berlin, N. W. 7, Germany. The price of the Index is 3.50 gold marks. The following specifications pertain either to trass or to trass-lime cement:

691.5—Bindemittel (Cementing materials).

DVM 1043 7.31 BL 1 Trass, Begriff, Eigenschaften (Trass, definition, properties).

DVM 1043 7.31 BL 2 Trass, Prufverfahren (Trass, method of testing).

DVM 1043 7.31 BL 3 Trassnormen-Kalkpulver, Normensand, Prufgerate (Specifications for trass-lime cement; standard sand; testing equipment).

DVM 1044 3.34 Trass, Chemische Untersuchung (Trass, chemical analysis).

The third standard, listed as (DVM 1043 7.31 BL 3), is the specification for pozzolanic cements, the pozzolanic material being referred to as *trass*, a volcanic tufa of light color, similar to pozzolana in its composition, and occurring especially on the lower Rhine.

The specifications listed above are, of course, printed in the German language. Copies (in German) may be obtained through the American Standards Association, 29 West 39th Street, New York.

Regarding translations, CONCRETE is able to refer inquiries to a private translator from whom typewritten copies (in English) may be obtained.

Use Shellac on Molds

I have added ornamental concrete work to my line of products, and I do most of this work with molds made of plaster of paris. I am having some trouble, because of the concrete sticking to the molds. How may this be prevented?—F. J. B., Oklahoma.

In all probability, the trouble you are having with plaster of paris molds can be avoided if you will paint the molds with two coats of thin shellac wherever the mold will be in contact with concrete. This coating of shellac serves the double purpose of preventing adhesion of concrete to the mold and preventing absorption of mixing water by the plaster of paris. This absorption of water by the plaster of paris sometimes has the effect of actually weakening the molded concrete, because of the extraction of an undue amount of the mixing water.

Comparative Tests of Brick Masonry

Can you refer me to tests conducted some years ago, in the East, to determine the comparative strength of concrete brick and clay brick masonry?—H. O. S., Kentucky.

The most notable comparative tests of concrete brick and clay brick masonry were conducted at Columbia University by Albin H. Beyer and W. J. Krefeld more than 13 years ago. In general, it can be said that concrete brick adheres to mortar much more effectively than clay brick. As a direct result of this fact, the strength of a finished concrete brick wall was found to be much greater than the strength of a clay brick wall. Because of the lack of cohesion between the clay brick and the mortar, walls of clay brick failed through the breaking of this bond.

The clay brick interests have made every possible effort to discredit the Columbia University tests, but the facts speak for themselves. An abstract of the Beyer and Krefeld report was published in the May (1923) issue of CONCRETE, page 167.

You are referred also to the Federal specification for concrete brick, designated as Specification SS-B-663, copies of which may be obtained at 5 cents each from the Government Printing Office, Washington, D. C.

Cast Stone to Match Granite

What materials and proportions would you recommend for cast stone to imitate Barre granite? We expect to add cast stone to our line of products.—F. R. J., New York.

You are referred to a short article headed "Matching Natural Stone," on page 24 of the June (1934) issue of CONCRETE.

As stated in that article, it is necessary in most cases to use aggregates (both fine and coarse) of crushed stone of the kind to be matched.

The proportions usually recommended are three parts of the crushed stone (combined fine and coarse material) and one part of cement. It is probable that some mineral color will also need to be used. If the stone to be imitated is of a reddish shade, you will probably find it necessary to use about 5 lb. of red oxide mineral color per sack of cement. If a more yellowish tint is required, about 2 lb. of either yellow or brown ochre might be tried. If the stone to be imitated is of a gray color, you may find it satisfactory to use three parts of crushed stone and one part of a fifty-fifty mixture of white and ordinary portland cement. In this last case, mineral colors may not be needed.

BOOKS On Concrete

List No. 2—Design and Construction, Concrete Making, Cement Manufacture

(Prices quoted are for cash in advance, and include postage)

DESIGN AND CONSTRUCTION OF FORM WORK FOR CONCRETE STRUCTURES. By A. E. Wynn. 320 pages, 219 ills., 12 folded inserts and 11 design tables. Cloth bound, stamped title in gold. Price **$6.00**

"Wynn's Book" is a phrase commonly known to engineers, designers, and foremen, and is heard wherever concrete construction is under way. This book covers every phase of forms for concrete construction, and is fully supplemented with many illustrations, tables and drawings and printed on a superior grade of enameled paper.

CONCRETE CONSTRUCTION MADE EASY. By Leslie Turner and Albert Lakeman. 113 pages, 65 illustrations, 16 tables. Cloth bound. Price **$2.00**

A practical book that solves problems in the design and erection of any type of concrete structure. Full designs with tables and all necessary information for building of foundations, walls, columns, floors, roofs, staircases, beams, water tanks, retaining walls, lintels, formwork, saw-tooth roofs, etc. Written clearly and plainly.

BASIC PRINCIPLES OF CONCRETE MAKING. By Franklin R. McMillan, Director of Research, Portland Cement Association. Ninety-nine pages, 6x9½, 32 illustrations and tables. Price **$2.00**

The author has culled the essentials out of a mass of scientific data on this subject and presents them with force and directness in this book. He shows the effects of quality of material, of proportioning, mixing, working and curing on the finished concrete.

The importance of variable mixes; tests for permeability; how to obtain strength, durability and watertightness; effective ratios; importance of proper construction methods—these and many other vital topics are discussed fully and authoritatively.

GENERAL ENGINEERING HANDBOOK. By Charles Edward O'Rourke and 29 associates. Flexible cover; 921 pages, 5 by 8 in., numerous tables, diagrams, and illustrations. Price **$4.00**

A great amount of fundamental engineering data in usable form, 31 separate sections dealing with as many specific branches of engineering. Of particular interest to engineers who specialize in the use of concrete as a structural material are sections devoted to "Highways," by Thomas R. Agg; "Reinforced Concrete Structures," and "Stresses in Framed Structures," by Charles Edward O'Rourke; "Engineering Materials," by Herbert H. Scofield; "Foundations," by Roland P. Davis; and "Mechanics," by Alfred P. Poorman.

REINFORCED CONCRETE CONSTRUCTION. By George A. Hool, Professor of Structural Engineering, University of Wisconsin.

Vol. I—Fundamental Principles. Third Edition. 380 pages, 6x9, 139 illustrations, 18 tables, 28 diagrams **$3.50**

Vol. II—Retaining Walls and Buildings. Second Edition. 700 pages, 6x9, illustrated........ **$6.00**

Vol. III—Bridges and Culverts, 688 pages, 6x9, over 600 illustrations, 41 plates........ **$6.00**

ESTIMATING AND COST KEEPING FOR CONCRETE STRUCTURES. By A. E. Wynn. Published in 1930; 272 pages, 92 illustrations, 2 folders. Price **$5.00**

The author of this book has had a wide experience in contracting for all kinds of concrete structures, and in this volume he publishes his own simple methods of estimating, cost-keeping and book-keeping. Reproductions are given of all blank forms required.

CONCRETE ENGINEERS' HANDBOOK. By George A. Hool and Nathan C. Johnson, assisted by S. C. Hollister, and with chapters by Harvey Whipple, Adelbert P. Mills, Walter S. Edge, A. G. Hillberg and Leslie H. Allen. 800 pages, 6 x 9. Illus. Flexible binding. Price **$6.00**

A compact reference book, containing tables, formulae and data on plain and reinforced concrete, covering the entire field.

CEMENT CHEMISTRY IN THEORY AND PRACTICE. By Prof. Dr. Hans Kuhl, Director of the Institute for Cement Research, Berlin. Translated into English by J. W. Christelow, B.Sc. 64 pages, 6 by 9, cloth cover. Illustrated with a number of halftones and diagrams. Price **$2.50**

An authoritative book on the chemistry of cement, a translation of a series of lectures delivered by Dr. Kuhl in Moscow, at the special request of the Soviet government. The author presents the most up-to-date knowledge of the subject in simple language. The result is a concise record of modern research on the manufacture and setting of cement. Chapter headings are: (1.) The Development of Cement Research; (2.) The Theory of Cement Burning; (3.) The Constitution of Portland Cement Clinker; (4.) The Problem of Hardening and Its Significance in Cement Research; (5) The Chemistry of High-Strength Cements; and (6.) The Technical Aspect of High-Strength Cements.

PORTLAND CEMENT. By A. C. Davis, works managing director, Associated Portland Cement Manufacturers, Ltd. Published in 1934. Cloth, 435 pages, 6½ by 9½ in., 262 illustrations, 22 tables. Price **$8.00**

A new book on cement manufacture, covering more especially the present-day British and continental practices. The author discusses and analyzes such important problems as modern manufacturing methods and organization; formation and nature of cement raw materials; factors governing choice of materials and manufacturing processes; advantages of dry and wet processes; raw material and clinker-grinding problems; improving the efficiency of the rotary kiln; methods of coal feed, slurry drying, and kiln control; reactions in burning cement; rotary kiln heat balances; conservation of heat in rotary kilns; advantages of the purchase of electricity compared with generation at the factory; modern methods of packing and shipping cement; production costs; mineralogy and chemistry of cement.

STANDARD CONSTRUCTION METHODS. By G. Underwood. 408 pages, 330 illustrations. Price **$5.00**

A complete, detailed presentation of actual methods used in practical construction work. A book packed from cover to cover with plans, short-cuts and expedients for construction superintendents and other men upon whom rests the responsibility of getting jobs done quickly and well.

REINFORCED CONCRETE AND MASONRY STRUCTURES. By Hool and Kinne. 722 pages, 6 x 9, illustrated. Price **$6.00**

The work of 14 specialists. This book offers a practical and detailed discussion of every important element entering into the design and construction of concrete and masonry structures. Particularly noteworthy are the very thorough treatments of Reinforced Concrete Buildings, Concrete Forms, Chimneys and Concrete Detailing.

HELPS TO SUCCESSFUL CONTRACTING. By Harry O. Locher. Published in 1934; 222 pages, 5½ by 8 in. Price **$2.00**

An unusual book for contractors, covering every phase of the work from estimating and bidding to cleaning up and moving to the next job. Written by an author with more than 30 years of experience in the contracting business. Every contractor and construction superintendent or foreman should have a copy.

WINTER CONSTRUCTION METHODS. By Charles S. Hill. Cloth, 180 pages, 6 by 9 in., illustrated. Price **$3.00**

This book assembles in one volume the practices found most effective in carrying on concrete construction work in cold weather. Subjects treated in individual chapters include construction of concrete bridges, roads and street pavements in winter; use of special cements in cold weather; heating of materials; handling and placing concrete; protectig concrete in heavy sections; progressive canvas housing for building construction; and use of complete enclosures.

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New Books and Pamphlets

Chemistry of Cement and Concrete

The Chemistry of Cement and Concrete, by F. M. Lea, of the Building Research Station, Watford, England, and C. H. Desch, of the National Physical Laboratory (England). Published by Longmans, Green & Co., New York, 1935. Cloth binding, 429 pages, 6 by 9 in., illustrated. Price $9.50.

This work has been written to give a general survey of the chemistry of cement and concrete, interpreting this term in a broad sense. The book is intended for the chemist, and also for the engineer and the architect who deal with cement and concrete. While many of the earlier chapters are devoted to matters of interest to the chemist alone, later chapters provide information on many problems of importance to engineers and architects.

The range of subjects covered include the chemistry of the changes which raw materials undergo during the process of manufacturing cement, and the effect on the finished product caused by changes in composition. The book does not cover the operation of cement manufacturing plants, nor does it attempt to describe cement-making machinery.

Highway Engineering

Principles of Highway Engineering, Second Edition, 1935. By Carroll C. Wiley, associate professor of highway engineering, University of Illinois. Published by McGraw-Hill Book Company, New York. Cloth binding, 542 pages, 6 by 9 in., with numerous tables, diagrams and halftone illustrations.

This volume is a modernization of the first edition, published in 1928. The text has been thoroughly revised and much of it is entirely rewritten. New developments in materials, methods, and basic principles, have been included.

The general order of treatment set forth in the first edition has been retained in the second. Materials are first considered separately before taking up their combination into roads and pavements, and the latter are developed before proceeding with the broader problems of design, finance and operation.

Low-Cost Concrete Homes

Twenty-Two Low-Cost Concrete Homes, published by Portland Cement Association, suggests 22 new designs for all types of small concrete masonry homes. Modern and formal styles are included for cottage, bungalow and two-story dwellings, 4 to 6 rooms in size. Floor arrangement and a front elevation sketch illustrate each design description. To illustrate further the type of homes anticipated by the plan suggestions, the booklet includes a seven-page pictorial section showing recently-built concrete masonry homes; concrete for home interiors; and concrete for garden and landscape use. The various finishes for masonry homes are described in two pages, one devoted to portland cement stucco, and another to concrete ashlar wall patterns.

Extensively illustrated throughout, this new booklet contains 32 pages bound in heavy paper cover. Copies may be obtained free, on request.

Better Concrete

Better Concrete is the title of a new illustrated 12-page booklet, 8½ by 11 in. in page size, published by the International Cement Corporation, 342 Madison Ave., New York. Copies free, on request.

This is a boiled-down manual containing a non-technical and straightforward discussion of the fundamentals of making good concrete, for the use of the small contractor. Separate sections cover the subjects of materials and proportions, mixing, placing, curing, forms and form-making, and steel reinforcement. There is also a tabulated outline of good job practice.

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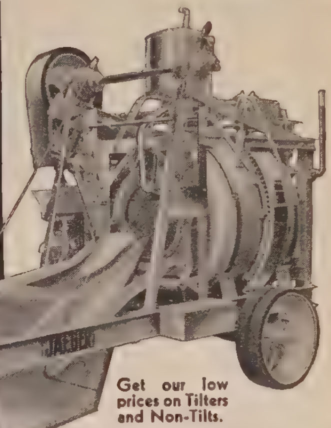

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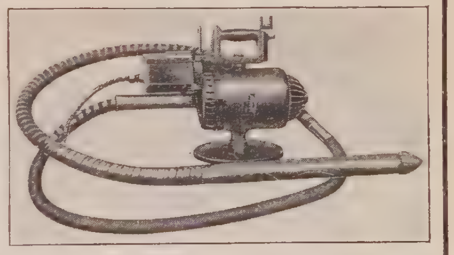

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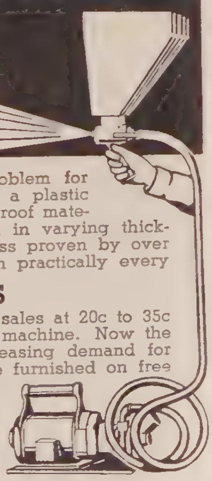

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EQUIPMENT AND MATERIALS

HUNT PROCESS—for curing concrete—is a compound of Bermudez asphalt and Gilsonite combined with a volatile solvent. It has a marked affinity, The Johnson-March Corporation (New York City) says, for unset concrete, adhering to the surface and forming a water-tight and air-tight seal. It dries rapidly, they say, and forms a film of uniform texture, having great flexibility and toughness and becoming a part of the surface without penetrating.

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ACE Super Sealer and Ace Super Finish are two distinct forms of the same product. Each is said to have the same waterproofing and chemical resisting qualities, the difference being mainly in body.

Ace Super Sealer is a very fluid, penetrative product for use in waterproofing wood, metal, concrete, stucco, pottery, tile, cement and plaster and for laying a suitable foundation for paint. Ace Super Finish is designed as a finish coat.

Hood Products Co., Detroit, says Ace is chemistry's answer to waterproofing and finishing problems.

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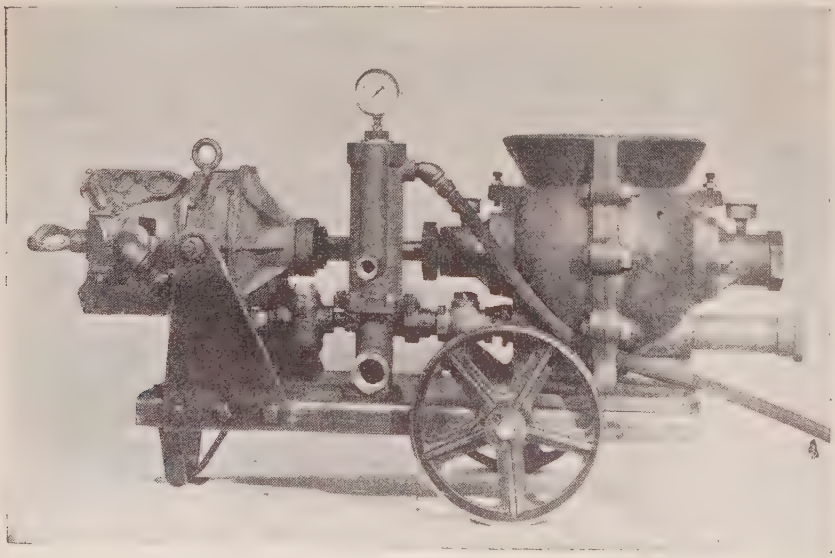
SPHERICAL Pneucrete Placer is a new machine of radically new design being placed on the market by the Pneucrete Equipment Company of Los Angeles, California, for the shooting of concrete into place.

The company claims dense pneumatically placed concrete at low cost with their machine.



The new Pneucrete placer

PATERSON vibratory screen, designed by D. S. Paterson, was placed on the market in February this year. The vibrator element is supported in an inverted U-shaped metal frame. The sieve basket fits into a quick-set clamp at the bottom of this frame. A motor-driven unbalanced weight, controlled by adjusting the position of the weight provides the vibratory motion. Sieve cloths are fastened in the seamless steel sieve baskets by a sieve lock ring inserted on top of the screen disc. A single wing-nut seats the disc. Discs are interchangeable and quickly replaceable.

Duplex sieve baskets, permitting of an additional separation, may be used.

The screen is easily portable and may be used for any liquid or solid material.

Arthur T. Ward, New York City, is distributor.

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THE DEVILBISS Company, working in cooperation with the American Cast Iron Pipe Co. of Birmingham, Ala., recently developed a special automatic gun outfit for coating the inside of cement-lined pipes with a heavy asphaltum water-proofing material.

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GRAVELITE, a light-weight aggregate, is manufactured from a mixture of hard shale and soft clay, by Gravelite, Inc., Point Richmond, Calif. After mining from an open-face quarry, it is sized and burned at a high temperature in a rotating furnace or kiln. This burning process is said to impart three essential properties — enduring permanence, lightness of weight and rounded contour.

Gravelite concrete, being used in the upper deck slab of the San Francisco-Oakland Bay bridge, is said to weigh only about 100 lb. per cubic foot as against 150 lb. for ordinary concrete—a considerable saving in the dead weight to be carried by the cables, trusses and foundations of the bridge.

Industrial Literature

EMBECO "Non-Shrink" Concrete Method for reintegration, maintenance and repair is the title of a 6-page leaflet published by The Master Builders Company, Cleveland, Ohio. This leaflet contains pictorial descriptions of twelve operations in the maintenance and repair of concrete work—seams disintegrated by laitance and water accumulating between pours in the original construction; honeycomb—segregation of aggregates due to improper mix and placement, also unsound aggregate; surface spalling—condition due to laitance brought to surface during original construction—poured too wet or frozen in cold weather; and natural wear plus the combined action of seams, honeycomb and surface spalling.

The company offers pictorial specifications and data to eliminate shrinkage in gunned placement of mortars.

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HELTZEL Steel Forms for Modern Road Construction is the title of Bulletin 101 now ready for distribution by the Heltzel Steel Form & Iron Co., Warren, Ohio. This is an 8-page booklet, well illustrated, setting forth the exclusive advantages of Heltzel road forms.

Bulletins Q6 and 7 are also available. These are entitled "The Rapid Dowel and Expansion Joint Spotter," and "The Heltzel Leveler Grader."

Manufacturers' News

George W. Jargstorff, formerly associated with C. K. Williams & Company of Easton, Pennsylvania, has become affiliated with the Smith Chemical & Color Company, of Brooklyn, New York. In his new connection, Mr. Jargstorff will handle the sales of colors and chemicals in the eastern district with headquarters at 55 John Street, Brooklyn.

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Albert Carl Lehman, 56, chairman of the board and founder of the original unit of the Blaw-Knox Company, Pittsburgh, died on July 24.

Vol. XLIII
No. 8

Cement Mill Section of
Concrete

August
1935

Efficient Lubrication of Cement Mill Machinery

Quantity of Oil or Grease Fed to Each Lubricating Point Must Be Regulated—How One System Applies Forced Feed

By M. J. HELMES
Lubricator Division, United American Bosch Corporation, Springfield, Mass.

IN the past decade all industrial forces were directed to push onward with production. A vast array of machinery equipment was built and put in operation, with little thought of economy. The life of a machine was seldom considered. Funds to acquire new machinery to speed up production were readily available.

The enormous quantities of oil and grease wasted to lubricate industrial machinery to keep it running seemed to be of no particular consequence. All was moving undisturbed on the crest of the wave of abundance, seemingly limitless. Progress stopped, as the advance at the tremendous pace we were going could not endure. For some time we were drifting along. The march down the road of many industries was rapid.

At that period, fortunately, there were some in the industrial field who had not only diagnosed one of the major contributing factors, but acted. Technicians and chemists of the producers of lubricating oils and greases for the diversified classes of industrial machinery have made, and are making, headway in improving their products. They have found the selection of the best lubricant for particular operating conditions to be of great importance. They have collected records of their work, and the experience gained by them has been a valuable contribution to our knowledge of lubricants and lubrication.

Application of Lubricants

The correct method of application of the lubricant was found to be the cardinal factor in efficient lubrication. This is properly accomplished by consistently feeding the lubricant to the points of lubrication in a quantity equal to the amount dissipated by friction—no more, no less.

Bearing this fact in mind, it becomes evident that the use of grease cups, periodic use of pressure guns and the like, do not meet the fundamental requirements. Any method of application of the lubricant which lacks rgulation of the quantity of oil or grease fed to a lubricating point is inadequate, since varying quantities of the lubricant are required for the different lubricating points of a machine.

Mechanical Lubricators

Far-reaching and outstanding developments in mechanical automatic positive forced-feed oil and grease lubrication were made to meet the demand for economy. The facility with which these mechanical lubricators can be adapted to lubricate efficiently any particular type of machine is due to the flexible design and construction of these greatly diversified apparatus. It is based on scientific facts and constitutes a guarantee for uninterrupted satisfactory service over a period of years.

Many among the operators of heavy machinery in cement mills realize that efficient lubrication is the major factor in bringing down maintenance costs and reducing power consumption. They are ever in search of better lubricating means.

Yet in numerous instances the man

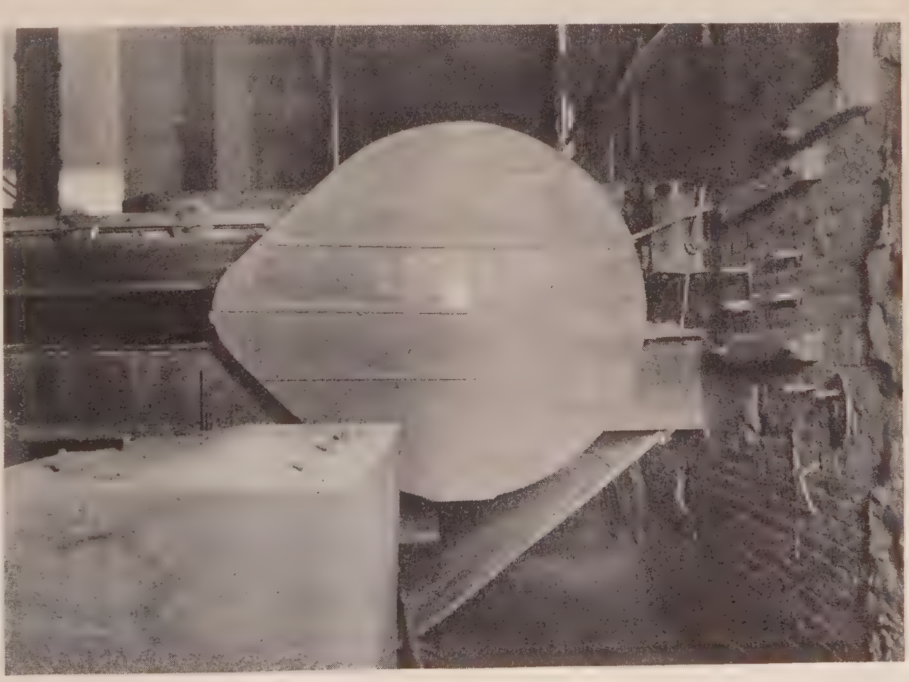

Fig. 1—Forced-feed grease lubrication of bearings of a hot clinker conveyor drive

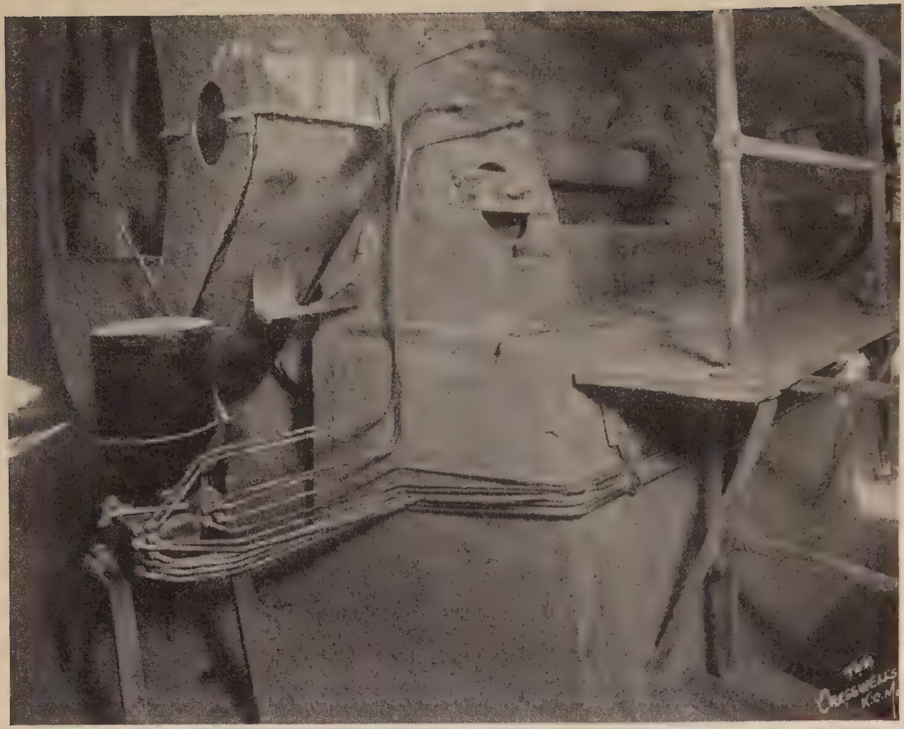

Fig. 2—Large bearings of crusher in cement plant lubricated with a forced-feed grease lubricator

in charge of operation is handicapped. He is reluctant to talk the matter over with those who are holding the purse string tight. There is, however, no reason for such hesitancy, since an indisputable benefit is derived by those who hold the lid down on the treasury chest.

To-day, big business men have a fine opportunity to show acumen by their approval of an investment which will be returned manifold. Builders of all classes of machinery, designers of production and power plants, are striving to incorporate adequate lubricating means in the construction of machines and machinery plants. A much more extended and wholehearted co-operation between the users and the builders of machinery will be of inestimable benefit to industries.

Applied to Cement Mill Machinery

Abundant evidence is available in support of the foregoing assertion. These facts are substantiated by the practical application of automatic forced-feed grease lubrication to the problem of reducing the cost of upkeep of cement mill machinery. The maintenance of a constant lubricating film of grease, no matter how inaccessible the bearings may be, is exemplified by the adaptation of automatic forced-feed grease lubrication to the bearings of a hot clinker conveyor drive, an illustration of which is shown in Fig. 1.

Efficient, economical lubrication of the large bearings of a Fairmount crusher in a well-known cement manufacturing plant is another case in point, and is the result of the adoption of automatic forced-feed grease lubrication to this heavy-duty machine. This installation is shown in Fig. 2. The equipment not only paid for itself in a short time in the reduction of repairs, but substantial savings were effected in the consumption of grease; and the human factor is eliminated.

Of equal interest is the safe and sure lubrication of the bearings of kiln drives by means of mechanical forced-feed grease lubricators, illustrated in Fig. 3.

Description of System

The oil and grease lubricating systems in these installations are fully automatic in their operation, they provide forced feed to the various points, and they may readily be adapted to individual conditions encountered.

In any given installation the system consists mainly of two parts—a cylindrical tank which serves as a container for the grease, the scoop, and the helical disc feeder; and a box-shaped cast-iron base which houses the entire pump system with its drive mechanism. This pumping mechanism is identical in the grease lubricator and the oil lubricator. It consists of concentrically arranged pump units and the pump shaft, with its two disc cams which actuate the pump plungers and the grease guide-plungers.

Working Parts Inclosed

All working parts are completely inclosed, thus being protected from cement mill dust. Nevertheless, these working parts are easily accessible. They are, of course, self-lubricating.

The drive shaft of the lubricator is driven from any suitable moving part of the cement mill machinery to which it is attached. The slowly rotating feeding mechanism pushes the grease contained in the tank through a strainer

(*Continued on page* 45)

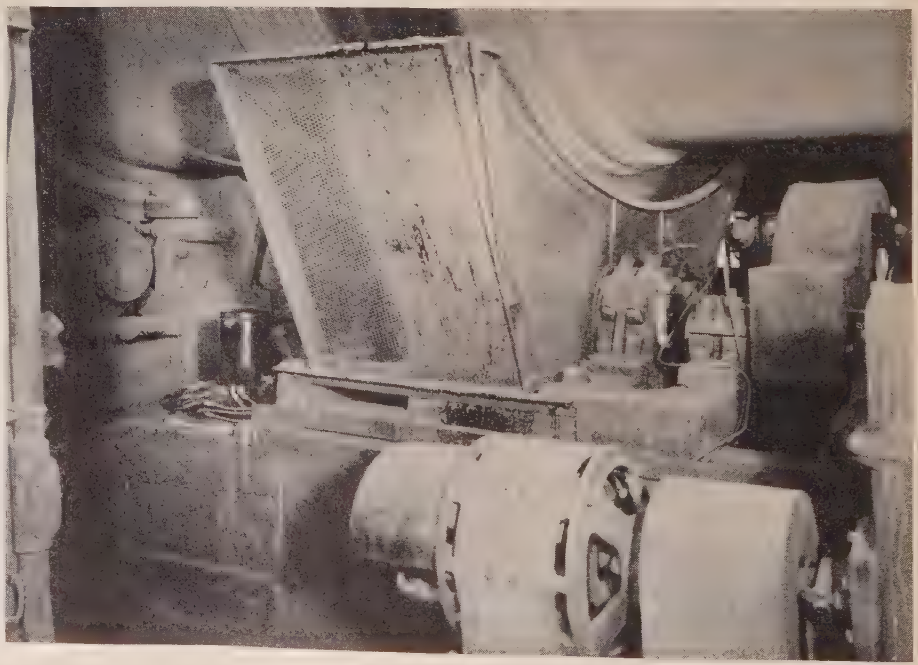

Fig. 3—Kiln drive lubricated with forced-feed grease lubricator

Rapid Determination of Magnesium

Two Separate Methods Developed by Diener and Redmond Published by A. S. T. M. Committee on Chemical Analysis

At the thirty-eighth annual meeting of the American Society for Testing Materials, held in Detroit during the last week in June, the A.S.T.M. Working Committee on Methods of Chemical Analysis presented two short methods for the determination of the percentage of magnesium in portland cement.

There is presented in Table 1 a digest of a preliminary study of the results obtained in analyzing several cements for magnesia by three methods. Two of these methods were developed by their authors (Diener and Redmond) as a means of quickly obtaining the final result, when compared with the time necessary to make the determination by means of the procedures described in the tentative Methods of Chemical Analysis of Portland Cement (C 114-34 T).[1] Since these newer methods are not generally known, they are presented herewith.

Rapid Volumetric Determination of Magnesia in Portland Cement[2]

By Fred P. Diener[3]

1. *Procedure.*—(*a*) To a 5.0-g. sample of cement in a 600-ml. beaker add about 50 ml. of water and mix the two by stirring. Add 50 ml. of HCl (1:1) and boil until the cement is completely in solution (Note 1), excepting possibly some silica which may separate out. Then add 5 ml. of saturated bromine water and continue the boiling until the excess bromine is completely expelled, as indicated by the absence of a blue coloration on potassium iodide-starch paper (Note 2) when held in the issuing steam (Note 3). Dilute to about 250 ml. with hot water and boil vigorously, add sodium hydroxide solution (20 per cent) from a pipette until a permanent precipitate is formed, stirring vigorously to prevent the precipitate from forming in large lumps. Then, while continuing the boiling and stirring add HCl (1:1) from a pipette until the solution is slightly acid, as noted when the solution assumes a yellow ferric chloride color, avoid much excess acid. Continue the boiling a minute to make certain that the precipitated material has been entirely dissolved (excepting some silica) and then remove the beaker from the burner.

(*b*) Cautiously add 4.0 g. of calcium carbonate (weighed to the nearest 0.1 g.) to the solution. The excess acid in the solution should be completely neutralized before all the $CaCO_3$ has been added; if not, too much excess acid was present. Dilute to about 400 ml. with hot water and boil the solution vigorously for about 10 min. Transfer the contents of the beaker to a 500-ml. volumetric flask, cool, dilute to the mark, and filter through a dry paper.

(*c*) After discarding the first 10 or 20 ml., transfer (with a 100-ml. pipette) 200 ml. of the filtrate to a 500-ml. Erlenmeyer flask. Heat to boiling and add 1.5 ml. of a saturated solution of trinitrobenzene (1-3-5) in ethyl alcohol (about 2 g. per 100 ml. of alcohol)—(Note 4). Then add 1/3 *N* carbonate-free NaOH solution (Note 7), 1 ml. at a time, with intermittent boiling for a few seconds, until the first faint pink color persists on boiling (Note 5). Add 1 ml. more alkali solution and boil for about 30 sec. Record the total amount of alkali used.

(*d*) Transfer the solution to a 250-ml. volumetric flask, cool, dilute to the mark, and filter through a dry paper, into a graduated cylinder, discarding the first 10 or 20 ml. of filtrate. The filtrate must be perfectly clear, or else the end-point in the succeeding titration will be very indistinct. Transfer 125 ml. of the filtrate to a flask, add 1 ml. of phenolphthalein indicator (0.1 g. per 100 ml. of 50 per cent ethyl alcohol), and titrate to the disappearance of the pink color with 1/3 *N* HNO_3 or HCl.

2. *Calculation.*—The milliliters of alkali minus twice the milliliters of

Table 1—Percentage Magnesia Content of Portland Cements as Determined by Different Methods

Method I: U. S. Bureau of Reclamation Specifications 599-D and 566 for Boulder Dam.
Method III: 8-Hydroxyquinoline Method of J. C. Redmond.
Method IV: Volumetric Method of F. D. Diener.

	Cement A*			Cement B			Cement C			Cement D		
Laboratory	Method I	Method III	Method IV	Method I	Method III	Method IV	Method I	Method III	Method IV	Method I	Method III	Method IV
No. 1	4.04	4.14	3.93	3.41	3.58	3.34	5.31	5.34	5.34	5.43	5.40	5.47
No. 2	4.08	4.22	4.16	3.45	3.46	3.44	5.37	5.16	5.36	5.55	5.18	5.36
No. 3	4.09	4.01	4.14	3.59	3.41	3.53	5.38	5.19	5.35	5.53	5.38	5.53
No. 4	4.10	3.92	......	3.51	3.24	......	5.51	5.27	......	5.66	5.43	......
No. 5	4.27	4.04	3.80	3.63	3.42	3.46	5.58	5.15	5.10	5.62	5.24	5.34
No. 6	4.46	4.11	4.75	3.79	3.56	3.90	5.73	5.45	5.70	5.89	5.55	6.15
No. 7	4.04	3.95	......	3.39	3.37	......	5.23	5.10	......	5.42	5.31	......
No. 8	4.24	......	......	3.58	......	......	5.59	......	......	5.72	......	......
No. 9	4.20	4.15	4.50	3.36	3.47	3.50	(4.80)	(4.64)	5.00	5.12	4.98	5.20
No. 10	4.47	(4.59)	4.38	3.77	(3.94)	3.98	5.68	(6.02)	5.56	5.92	(6.12)	5.95
Averages†	4.20	4.07	4.24	3.55	3.44	3.59	5.49	5.24	5.34	5.59	5.31	5.57

*Careful analysis of Cement A under the supervision of G. E. F. Lundell, National Bureau of Standards, showed a magnesia content of 4.07 per cent. This determination was not made by Method I.

†Averages are the mean of results reported by laboratories, omitting values in parentheses.

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[1] Accepted for publication as tentative by Committee E-10 on Standards, December 27, 1934. Issued in separate pamphlet form.

[2] This procedure is a modification of the method originally published by Fred P. Diener in Concrete, Vol. 39, No. 6, December, 1931. The changes, which are in minor details and do not affect the underlying principles of the method, were made by the author in co-operation with the Working Committee on Methods of Chemical Analysis of Cement of the A.S.T.M. Committee C-1 on Cement for use in the investigations sponsored by the working committee. The theory of the method is discussed in the original article.

[3] Assistant Chief Chemist, Northampton Plant, Universal Atlas Cement Co., Northampton, Pa.

acid represents the magnesium in a 2-g. sample (Notes 6 and 8).

Explanatory Notes

Note 1.—Some samples, particularly those containing manganese, may require longer boiling or the addition of slightly more HCl to effect complete solution.

Note 2.—The potassium iodide-starch paper may be prepared by mixing equal volumes of a 5 per cent potassium iodide solution and a 1 per cent soluble starch solution, and dipping strips of filter paper into the mixture.

Note 3.—An operator who is not familiar with the method and finds it difficult to control the addition of NaOH and HCl prior to the addition of calcium carbonate, may find the following steps helpful: When the excess bromine is completely expelled, add about 75 ml. of hot water and filter and wash the residue. Dilute the filtrate to about 250 ml. with hot water and bring it to a vigorous boil. Approximately 30 ml. of the NaOH solution will be required at this stage. Keeping the solution at a vigorous boil and stirring it vigorously, add the last portion of the reagent slowly and carefully until the solution becomes turbid or until a slight flocculent, and permanent precipitate is formed. A small excess of acid as shown by the yellow ferric chloride color should remain. It is not necessary to add more NaOH or HCl. Continue with the rest of the procedure, beginning with the addition of calcium carbonate.

Note 4.—The solubility of the indicator in alcohol is affected by the amount of water in the alcohol and varies from about 1 per cent in 90 per cent alcohol to about 2 per cent in 100 per cent alcohol. If the strength of the solution is less than 2 per cent, a correspondingly larger amount should be used in the determination. There are three possible isomeric forms of trinitrobenzene; it is important that the correct form (1-3-5) is used.

Note 5.—Enough standard alkali should be added to completely precipitate the magnesium without any precipitation of calcium. A guide to proper procedure is the amount of back titration with acid, which should be held between 1.0 and 2.0 ml. (after being doubled). A little experience with the color change of the trinitrobenzene indicator will enable the operator to hold the back titration between these limits.

Note 6.—A blank determination should be made, using approximately the same amounts of reagents as specified in the regular method of analysis, and exercising particular care to get about the same amount of calcium carbonate in the solution. This blank is generally quite appreciable (amounting from 0.12 to 0.17 per cent MgO) and, once determined for a particular batch of chemicals, should be subtracted from each determination made.

Note 7.—A good many cement laboratories use the acid-alkali method of raw mix control or some modification of it. A convenient feature of this rapid magnesium method is that the same acid and alkali solutions may be used. However, it is important that the alkali solution be absolutely free of carbonate to avoid precipitation of calcium carbonate along with the magnesium hydroxide. This may be conveniently done by adding about 10 to 15 ml. of a freshly prepared, saturated barium hydroxide solution to each liter of alkali solution. After filtering off the precipitated barium carbonate, or siphoning off the clear supernatent solution, with as little exposure to air as possible, the solution is standardized by any of the accepted methods. The solution should be kept in a tubulature bottle fitted with an automatic burette, and the top of the bottle and the burette fitted with soda-lime tubes to protect it from the carbon dioxide in the air.

Note 8.—This method makes no provision for the presence of manganese. If it is present it will be included in the magnesium.

The Precipitation and Titration of Magnesium Oxyquinolate in the Presence of Calcium Oxalate, and Its Application in the Analysis of Portland Cement and Similar Silicates[4]

By John C. Redmond[5]

1. *Solutions Required:* (*a*) *8-Hydroxyquinoline* (*1.25* per cent.)—Dissolve 25 g. of 8-hydroxyquinoline in 60 ml. of glacial acetic acid. When the solution is complete, dilute to 2 liters with cold water. One milliliter is equivalent to 0.0016 g. of MgO.

(*b*) *Sodium Thiosulfate Solution* (*0.1 N*).—Dissolve 25 g. of $Na_2S_2O_3.5H_2O$ in 200 ml. of water and dilute to 1 liter. Standardize this solution either on sodium oxalate through a permanganate solution, or an arsenious oxide through a solution of resublimed iodine. Standard Samples No. 40c and 83 of the Bureau of Standards are convenient for this purpose. One milliliter of exactly 0.1 *N* sodium thiosulfate solution is equivalent to 0.000504 g. of MgO.

(*c*) *Potassium Bromate - Potassium Bromide Solution* (*0.2 N*).—Dissolve 20 g. of KBr and 5.57 g. of $KBrO_3$ in 200 ml. of H_2O and dilute to 1 liter. Obtain the ratio of this solution to the standard sodium thiosulfate solution as follows: To 200 ml. of water in a 400-ml. beaker add exactly 25 ml. of bromate solution. Add 20 ml. of HCl (sp. gr. 1.19), stir, and add immediately 10 ml. of KI solution. Mix well and titrate at once with the sodium thiosulfate solution until nearly colorless. Add 2 ml. of starch solution, and titrate to the disappearance of the blue color.

(*d*) *Potassium Iodide Solution* (*25 per cent*).—Dissolve 25 g. of KI in 100 ml. of water.

(*e*) *Starch Solution.*—To 500 ml. of boiling water add a cold suspension of 5 g. of soluble starch in 25 ml. of water, cool, add a cool solution of 5 g. of NaOH in 50 ml. of water, add 15 g. of KI and mix thoroughly.

2. *Procedure.*—(*a*) To a 0.500-g. sample of cement in a 400-ml. beaker add 10 ml. of water and 10 ml. of HCl (sp. gr. 1.19). Heat gently and grind any coarse particles until decomposition is complete. Dilute to 100 ml. with hot water.

(*b*) To the solution add three drops of methyl red (0.02 per cent alcoholic solution), and then NH_4OH (sp. gr. 0.90) until the solution is distinctly yellow. Heat to boiling, boil for 1 to 2 min., remove from the hot plate, and allow to stand until the precipitate has settled. Filter without delay, and wash the precipitate twice with a hot solution (2 per cent) of ammonium chloride. Transfer the precipitate with the filter paper to the beaker and dissolve in 10 ml. of HCl (1:1). Dilute to about 100 ml. and heat to boiling. Reprecipitate the hydrates, filter, and wash as above. To the filtrate add 1 ml. of NH_4OH (sp. gr. 0.90), and heat to boiling. When boiling, add 25 ml. of a hot solution (4 per cent) of $(NH_4)_2C_2O_4.H_2O$ and continue boiling for 2 min. Digest on the steam bath for 10 to 15 min.

(*c*) Cool the solution to 70 C, add 10 to 25 ml. of the 8-hydroxyquinoline reagent (Note 9), and then 4 ml. of NH_4OH (sp. gr. 0.90) per 100 ml. of solution. Stir on a mechanical stirring machine for 15 min., and set aside until the precipitate has settled (Note 10). Filter, and wash with hot dilute NH_4OH (1:40). Dissolve the precipitate in 50 to 75 ml. of hot dilute HCl (1:9), dilute the resulting solution to 200 ml., and add 15 ml. of HCl (sp. gr. 1.19). Cool to 25 C. and add from a pipette 10 to 35 ml. of the standard bromate solution (Note 11). Stir and let stand for about 30 sec. to insure complete bromination. Add 10 ml. of the KI solution, stir well, and then titrate with

(*Continued on page 46*)

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[4] This procedure is a modification of the procedure originally published by J. C. Redmond in the Bureau of Standards *Journal of Research*, Vol. 10, No. 6, June, 1933. The revision was made after correspondence with Mr. Redmond and for use in investigations sponsored by the Working Committee on Methods of Chemical Analysis of Cement of the A.S.T.M. Committee C-1 on Cement. The revised procedure differs from the original one mainly in two respects: (1) The hydrates of iron and aluminum are precipitated twice instead of once; and (2) the amounts of 8-hydroxyquinoline reagent and standard bromate solution used are variable instead of fixed.

The original article should be consulted for a discussion of the theory and experimental basis of the method. The method was developed primarily for use by the National Bureau of Standards for the detection of cements whose magnesia content did not meet the requirements of Federal Specifications Board Specification No. 1a. For use in the investigations of the working committee, the method was so revised that the magnesia content of any cement might be determined rapidly and correctly.

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◆ EDITORIAL ◆

Avoid This Danger Leaders of the cement industry are concerned over the present unorganized state of affairs, now that its code of fair competition is out of the picture and for the present, at least, there is nothing to take its place.

And well may they be concerned, for next January is approaching — the time of year when state and county highway departments will be asking for bids on large quantities of cement.

It is always good politics—even though it may be poor business—to reject the first bids received, especially when the rejection is accompanied by an angry blast against the "cement trust." Such blasts always make the front page; and front-page copy of that kind is music to the ears of the public official who plays the hero's part in the story.

We know, all too well, that there is dynamite in the situation created through the rejection of bids for highway cement. The opening of the first bids has turned all the cards up. In consequence, the situation offers a strong temptation to turn in new bids, not on the basis of manufacturing costs, but on the basis of previous figures quoted by competitors. In short, the situation presents a strong temptation to cut prices.

Everyone who is interested in the welfare of the cement manufacturing industry is hoping in all sincerity that the leaders of this group may succeed in getting the industry organized prior to next January on some co-operative marketing basis — some self-governing basis that will be in step with the Supreme Court decision of March 13, 1933, in the *Appalachian Coals* case.

The marketing organization built up by the coal industry as a result of that decision was described in an article in last month's issue of the *Cement Mill Edition* of CONCRETE. The *Appalachian Coals* marketing agreement stands out as a prominent landmark to guide other basic industries.

Will the cement manufacturing industry have the vision to build an analogous organization?

Publicity Stops a Promoter Promoters of new cement manufacturing plants have a habit of bobbing up at irregular intervals; but through the so-called blue sky laws of a number of states, and at times through the federal securities act, means may be found to put a stop to their activities.

This is true, at least, in cases where an attempt is made to sell stock to the general public, as E. S. Gates, a former broker of El Paso, Texas, is finding out.

The activities of this promoter were mentioned on this page in our issue of February, 1934. Gates was one of the promoters of a small cement plant built in Chubbuck, California, in 1928, known as the National Portland Cement Company. One small kiln, 5 by 50 ft., was installed, but the plant never was in sustained operation. Hundreds of investors at El Paso, where Gates operated, put money into the Chubbuck plant.

Now, according to the El Paso *Herald-Post*, Gates is making a second effort to sell stock in a new company, to be known as the International White Cement Company. This new company, he claims, has an option on an existing plant in California.

The *Herald-Post* claims there are no records at the state capital to indicate that the International White Cement Company has obtained any license to sell stocks in Texas. An investigation has been inaugurated by the Texas State Securities Commission, according to the newspaper; and the resulting publicity will, in all likelihood, put an end to this venture.

No State Plant in Wisconsin During the debate on the proposed bill to create a legislative committee to investigate the feasibility of building a state-owned cement plant in Wisconsin, one legislator made a suggestion that was embarrassing to the supporters of the bill.

This legislator was Assemblyman Vernon Thompson, of Richland Center, Wisconsin. He was inconsiderate enough to remind his fellow legislators that in 1924 a legislative committee had made a thorough investigation of the advisability of building a state-owned cement plant. All that was necessary, he contended; was for the legislature to call up and consider the report turned in by the 1924 committee.

Of course, this sensible suggestion was not favorably received by the advocates of the proposed bill. It is quite unusual for legislators to make use of information already at hand, in matters of this kind. A new investigation, even though it may cover the same ground and bring out the same facts, provides much more opportunity for political showmanship and personal publicity.

In the end, the proposed bill was defeated by a vote of 52 to 37. Wisconsin will not have a state-owned cement plant—at least not for the present.

Clay-Gypsum Cement—Composition and Manufacture

Influence of Burning Temperature—Processes Occurring During Hardening of Clay-Gypsum Cement

By DR. PETER P. BUDNIKOFF
Professor, Laboratory of Silicate Technology, Institute of Chemical Technology, Charkoff, U.S.S.R.

THE previous installment of this article, appearing in the July issue, describes the investigation that demonstrated the value of dead-burned gypsum when included with mixtures of clay and air-slaked lime, in the production of the type of cement under discussion. This final installment contains data on the influence of the burning temperature, and the processes taking place during the setting of clay-gypsum cement are described.

Influence of the Burning Temperature of Kaolin on Its Activity

In an investigation of the influence of the burning temperature of kaolin on its activity, washed kaolin from Prosjanaja (Ukrainia) was burned from 500 to 1,150 deg. C.

The activity was determined in a diphenyl-methane calorimeter from the heat evolved from the reciprocal action of burned kaolin with the saturated solution of calcium hydroxide. The results of the investigation are shown in Table 7.

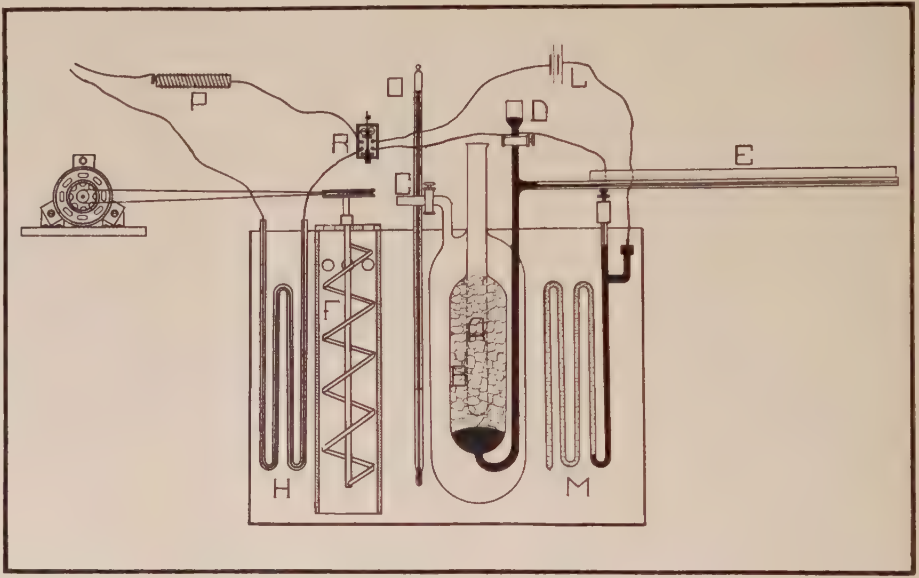
As may be seen from Table 7, the greatest activity is disclosed by kaolin when burned at 800 deg. C.—11.90 calories were evolved by 1 gram of burned kaolin.

The heat of formation of a prepared clay-gypsum cement has also been determined. The cement had the following composition:

70 per cent Prosjanaja kaolin, burned at 800 deg. C.
20 per cent anhydrite ($CaSO_4$).
10 per cent air-slaked lime, $Ca(OH)_2$.

The quantity of heat evolved when this cement was mixed with water is shown in Table 8.

The heat of formation evolved in this case included that arising from the hydration of anhydrite ($CaSO_4$) in the presence of $Ca(OH)_2$. This quantity of heat of formation was determined sep-



Diphenyl-Methane Calorimeter

A. Calorimeter.
B. Protecting wrapping.
C. Tube for the evacuation of air.
D. Funnel for filling with mercury.
E. Capillary.
F. Mixer.
H. Heater.
L. Accumulator.
M. Thermo-regulator.
O. Thermometer.
P. Rheostat.
R. Relay.

Table 7—Influence of Burning Tem

Temperature in Deg. C. Time		500 deg.		600 deg.		700 deg.		750 deg.		800 deg.
Hours	Min.	Calories per 30 minutes	Total Calories	Calories per 30 minutes	Total Calories	Calories per 30 minutes	Total Calories	Calories per 30 minutes	Total Calories	Calories per 30 minutes
0	30	2	2	1.68	1.68	4.00	4.00	2.94	2.94	0.425
1	00	1	3	2.94	4.62	2.00	6.00	3.36	6.30	0.425
1	30	0.4	3.4	0.84	5.46	3.50	9.50	2.10	8.40	0.425
2	00	0	3.4	0.42	5.88	0.5	10.00	1.68	10.08	0.425
2	30	0	3.4	0	5.88	0.25	10.25	0.64	10.72	0.425
3	00	0	3.4	0	5.88	0	10.25	0.42	11.14	0.425
3	30	----	----	----	----	----	----	----	----	0.425
4	00	----	----	----	----	----	----	----	----	0.85
4	30	----	----	----	----	----	----	----	----	0.85
5	00	----	----	----	----	----	----	----	----	0.425
5	30	----	----	----	----	----	----	----	----	0.425
6	00	----	----	----	----	----	----	----	----	0.425
6	30	----	----	----	----	----	----	----	----	0.425
7	00	----	----	----	----	----	----	----	----	0.85
7	30	----	----	----	----	----	----	----	----	0.85
8	00	----	----	----	----	----	----	----	----	0.85
8	30	----	----	----	----	----	----	----	----	0.425
9	00	----	----	----	----	----	----	----	----	0.425
9	30	----	----	----	----	----	----	----	----	0.85
10	00	----	----	----	----	----	----	----	----	0.85
10	30	----	----	----	----	----	----	----	----	0.85
11	00	----	----	----	----	----	----	----	----	0.63
11	30	----	----	----	----	----	----	----	----	----
12	00	----	----	----	----	----	----	----	----	----

TABLE 8—HEAT OF HARDENING OF CLAY-GYPSUM CEMENT

Time Hours	Minutes	Total calories
0	10	0.
0	20	0.47
0	30	1.41
0	40	2.35
0	50	4.23
1	00	9.40
1	10	10.57
1	20	10.81
1	30	10.81
1	40	10.81
1	50	11.28
2	00	11.28
2	10	11.28

arately.[8] For this separate determination, one part of $Ca(OH)_2$ was taken for every 2 parts of $CaSO_4$—that is, the same proportions in which they were present in the clay-gypsum cement. The results of this investigation are shown in Table 9.

TABLE 9—HEAT EVOLVED IN HYDRATION OF $CaSO_4$ IN PRESENCE OF $Ca(OH)_2$

Time		Total	Time		Total
Hours	Min.	Calories	Hours	Min.	Calories
0	10	0.47	1	00	2.82
0	20	1.17	1	10	3.05
0	30	1.41	1	20	3.28
0	40	1.64	1	30	3.76
0	50	2.38	1	40	3.76
			1	50	3.99

Owing to the fact that the amount of anhydrite and $Ca(OH)_2$ in the clay-gypsum cement amounted to 30 per cent, the quantity of heat evolved on account of the hydration of anhydrite ($CaSO_4$) contained in it will be, for the period indicated, $3.99 \times 0.30 = 1.193$, or 1.2 calories. It follows that the heat evolved through the reciprocal action of kaolin, $Ca(OH)_2$ and $CaSO_4.2H_2O$ will be $11.28 - 1.20 = 10.08$ calories for 0.7 gr. of kaolin (See Tables 8 and 9).

Admitting that the heat evolved will be in a proportional relation to the quantity of kaolin, we will obtain $\frac{10.08}{0.7} = 14.4$ calories per gram of kaolin, which is a trifle more than that indicated in the case of the action of $Ca(OH)_2$ (See Table 7).

This justifies us in assuming the possibility of reciprocal action of $CaSO_4.2H_2O$ with burned kaolin. These conjectures are confirmed by our observations of the reciprocal action of the constituent components of cement under a microscope.

To this end we prepared a series of samples, including the materials under discussion, and combinations of them, which were mixed with water on the object glass.

With the microscope (80 diameters) new formations could be observed that were not in evidence in the separate materials—long cobweb-like crystals of calcium hydro-sulfo-aluminate ($3CaO.Al_2O_3.3CaSO_4.30H_2O$), and very fine lamellae of irregular form with a diameter of $\frac{1}{1,000}$ mm., with a low (scarcely noticeable) interferential coloring, which, as it seems, belong to double salts of calcium sulfate with Al_2O_3 or SiO_2.

With the purpose of determining to a certainty that these lamellae do not belong to calcium hydro-sulfo-aluminates having a smaller content of lime, which might possibly be formed because of a comparatively small addition of $Ca(OH)_2$, samples without any lime content were prepared. These samples were made from kaolin and anhydrite, in which the lamellae previously mentioned were again found.

With respect to the formation of calcium hydro-sulfo-aluminates in clay-gypsum cement, it can be assumed that the activity of the alumina in clay burned at 700 to 900 deg. C. is sufficiently high to bring about this result.

This encouraged us to investigate the activity of alumina, to determine the amount of heat evolved in the process of interaction with $Ca(OH)_2$. For this investigation the alumina used was obtained by precipitation from a solution aluminum sulfate. The alumina was subjected to calcination at different temperatures.

The determination of activity was made by means of a diphenyl-methane calorimeter. The data obtained from this investigation are shown in Table 10.

The results obtained lead to the conclusion that in spite of the drop in activity of alumina coincident with the rise in burning temperature, the alumina contained in clay burned at temperatures commonly employed in the burning of clay-gypsum cements is of great importance.

Physical tests demonstrated that considerable activity of alumina can be observed in cases where high-alumina clays are employed. The cement made from such clay (See Tables 5A, 5B, and 5C), owing to the activity of the

PERATURE OF KAOLIN ON ITS ACTIVITY

800 deg.	850 deg.		900 deg.		1,000 deg.		1,100 deg.		1,150 deg.	
Total Calories	Calories per 30 minutes	Total Calories	Calories per 30 minutes	Total Calories	Calories per 30 minutes	Total Calories	Calories per 30 minutes	Total Calories	Calories per 30 minutes	Total Calories
0.425	3.00	3.00	1.50	1.50	1.00	1.00	0	0	0	0
0.85	3.00	6.00	1.50	3.00	1.50	2.50	0.25	0.25	0	0
1.27	1.50	7.50	3.00	6.00	1.50	4.00	0	0.25	0	0
1.70	0.75	8.25	1.50	7.50	2.50	6.50	0	0.25	0	0
2.12	0.50	8.75	1.00	8.50	1.50	8.00	0.25	0.50	0	0
2.55	0.50	9.25	1.00	9.00	0.25	8.25	0	0.50	0	0
2.97	0.25	9.50	0.50	9.50	0.25	8.50	0	0.50	0	0
3.82	0	9.50	0	9.50	0	8.50	—	—	—	—
4.67	0	9.50	0	9.50	0	8.50	—	—	—	—
5.10	—	—	—	—	—	—	—	—	—	—
5.52	—	—	—	—	—	—	—	—	—	—
5.95	—	—	—	—	—	—	—	—	—	—
6.80	—	—	—	—	—	—	—	—	—	—
7.65	—	—	—	—	—	—	—	—	—	—
8.50	—	—	—	—	—	—	—	—	—	—
8.92	—	—	—	—	—	—	—	—	—	—
9.35	—	—	—	—	—	—	—	—	—	—
10.20	—	—	—	—	—	—	—	—	—	—
11.05	—	—	—	—	—	—	—	—	—	—
11.27	—	—	—	—	—	—	—	—	—	—
11.90	—	—	—	—	—	—	—	—	—	—
11.90	—	—	—	—	—	—	—	—	—	—
11.90	—	—	—	—	—	—	—	—	—	—
11.90	—	—	—	—	—	—	—	—	—	—

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[8] P. P. Budnikoff and L. Gulinowa, Kolloid. Zeitschr. Bd. 67, 1934, pp. 88-93. Ibid., Kolloid. Zeitschr. Bd. 70, 1935, pp. 100-105. Ibid., Proceedings Acad. of Science, Un. S. S. R., No. 7, Dec. 1, 1934, pp. 404-411.

Table 10—Activity of Al_2O_3

Temperature in Deg.C Time		120 deg.		500 deg.		800 deg.		1,000 deg.		1,100 deg.	
Hours	Min.	Calories every 5 minutes	Total Calories	Calories every 5 minutes	Total Calories	Calories every 5 minutes	Total Calories	Calories every 5 minutes	Total Calories	Calories every 5 minutes	Total Calories
0	05	3.44	3.44	--------	--------	--------	--------	2.58	2.58	0.0	0.0
0	10	8.60	12.04	11.75	11.75	10.34	10.34	4.73	7.31	----	----
0	15	4.30	16.34	--------	--------	--------	--------	2.15	9.46	0.0	0.0
0	20	3.01	12.35	4.23	15.98	4.70	15.04	1.29	10.75	----	----
0	25	1.29	20.64	--------	--------	--------	--------	0.86	11.61	0.0	0.0
0	30	0.86	21.50	3.29	19.27	1.88	16.92	0.86	12.47	----	----
0	35	0.86	22.36	--------	--------	--------	--------	0.43	12.90	0.0	0.0
0	40	0.43	22.79	0.94	20.21	1.88	17.80	0.215	13.115	----	----
0	45	0.43	23.22	--------	--------	--------	--------	0.215	13.33	0.0	0.0
0	50	0.43	23.65	0.94	21.15	0.94	18.74	0.0	13.33	----	----
0	55	0.0	23.65	--------	--------	--------	--------	0.0	13.33	0.0	0.0
1	00	0.0	23.65	0.47	21.62	0.0	18.74	0.0	13.33	----	----
1	05	--------	--------	--------	--------	--------	--------	--------	--------	0.0	0.0
1	10	--------	--------	0.0	21.62	0.47	19.21	--------	--------	----	----
1	15	--------	--------	--------	--------						
1	20	--------	--------	--------	--------	0.0	19.21	--------	--------	—	—

Al_2O_3 of such clay, reacts quickly with $Ca(OH)_2$ and $CaSO_4$, thus leading to high strength in the early hardening periods, and lowering of the strength afterwards. This last-named phenomenon evidently takes place as a result of the formation of a large quantity of hydro-sulfo-aluminate.

In addition to the investigation described above, the influence of temperature on the solubility of alumina in hydrochloric acid was determined. For this purpose 0.5 gr. of Al_2O_3 was burned in a Heraeus electric furnace during a period of 2 hours. The calcined alumina was boiled for 15 minutes with 100 cu. cm. of 2N.HCl in a retort having an inverted cooler. The results are shown in Table 11.

Table 11—Influence of Temperature on Solubility of Alumina in HCl

Test number	Burning temperature, deg. C.	Per cent dissolved
1	450	77.05
2	650	66.55
3	750	49.76
4	850	29.04
5	950	21.88
6	1,000	13.06

The data on solubility of Al_2O_3 and on the heat evolved in the process of interaction of Al_2O_3 with $Ca(OH)_2$ demonstrate the coincidence of the drop in activity of alumina with the rise of the burning temperature.

Processes Taking Place During Setting of Clay-Gypsum Cement

The following reactions are possible when clay-gypsum cement is mixed with water:

Anhydrite ($CaSO_4$) hydratizes under the influence of $Ca(OH)_2$, thus:

$$CaSO_4-2H_2O=CaSO_4.2H_2O$$

The formation of $CaSO_4.2H_2O$ is seemingly one of the factors that lead to a comparatively high early physical strength of cement.

In time, the process of the formation of hydro-aluminates and hydro-silicates takes place.

The formation of hydro-silicates takes place on account of the interaction of the residual activity of silica (of kaolinite anhydride and of free silica, if it was present in the clay) with $Ca(OH)_2$, according to the reaction—

$$SiO_2+Ca(OH)_2+nH_2O=CaO.SiO_2.2.5H_2O$$

In the case of clays having a high content of alumina (Al_2O_3), the formation of calcium hydro-sulfo-aluminates is also observed, as mentioned above.

The possibility of the formation of double salts of calcium sulfate with Al_2O_3 and SiO_2, and of calcium alumino-silicates from interaction with kaolinite anhydride ($Al_2O_3.2SiO_2$) with $Ca(OH)_2$, is also not eliminated.

Conclusions

(1) Clay-gypsum cement can be produced by a combined grinding of clay burned at 700 to 900 deg. C., gypsum burned at about 700 deg. C., and $Ca(OH)_2$.

(2) The following compositions of cement are the most expedient:

(a) Local clay, burned at about 900 deg. C. ....70 per cent
Anhydrite, obtained by burning gypsum at 600 to 700 deg. C. ....20 per cent
Air-slaked lime, $Ca(OH)_2$ ....10 per cent

(b) Local clay, burned at about 900 deg. C. ....30 per cent
Anhydrite, obtained by burning gypsum at 600 to 700 deg. C. ....60 per cent
Air-slaked lime, $Ca(OH)_2$ ....10 per cent

(c) Local clay, burned at about 700 deg. C. ....30 per cent
Anhydrite, obtained by burning gypsum at 600 to 700 deg. C. ....60 per cent
Air-slaked lime, $Ca(OH)_2$ ....10 per cent

(3) To obtain clay-gypsum cement of high quality, local clays similar to those described in this report are the most appropriate.

(4) A high content of alumina in the clay increases the strength of the cement only during the early hardening periods, and lowers it later on.

Tabulation of Technical Conditions of Clay-Gypsum Cement

A.—Definition

Clay-gypsum cement is a product obtained by a combined grinding of (1) clay, burned at 700 to 900 deg. C.; (2) anhydrite, obtained by burning gypsum at 600 to 700 deg. C.; and (3) air-slaked lime.

B.—Uses

Clay-gypsum cement can be used for interior and exterior plastering and stucco, since it possesses considerable resistance to the influence of water.

C.—Technical Conditions

(*a*) *Composition.* The completed product must contain not less than 20 per cent of anhydrite, by weight, and not less than 10 per cent of air-slaked lime.

Note:—The quantitative relation of the components depends on the physical-chemical properties of the clay and on the quality of the air-slaked lime.

(*b*) *Time of Setting.* The initial set must occur not earlier than 30 minutes from the beginning of mixing; the final set, not later than 12 hours.

(*c*) *Constancy of Volume.* Clay-gypsum cement must demonstrate constancy of volume in water, and also under the boiling test.

(*Continued on page* 45)

Influence of Fluorides

Japanese Investigators Determine Effects of Fluorides on Thermal Synthesis of Calcium Aluminates and Calcium Silicates

An extensive series of tests to determine the effects of fluorides on the thermal synthesis of calcium aluminates and calcium silicates is reported in a paper presented to the Japanese Society of Chemical Industry by Shoichiro Nagai and Toyotara Yoshiura. Following is a translation of the report as it appears in the April (1935) issue of *Cement and Cement Manufacture* (London).

Calcium Aluminates

There is very little information available on the effects of calcium fluoride and other fluorides on the thermal synthesis of calcium aluminates, which are the main hydraulic compounds of portland cement and high alumina cement. Mr. Nagai, in co-operation with M. Miyasaka, has recently reported studies on the effects of calcium fluoride on the thermal synthesis of calcium silicates* and is now continuing the studies. The effects of calicum fluoride on the thermal synthesis of calicum aluminates are now being studied by the same method, and the following are the main points of the first report.

Use Pure Chemicals

The raw mixtures were made from the pure chemicals—calcium carbonate, alumina, calcium fluoride, etc. — in the molecular ratios of (1) $3CaCO_3$:Al_2O_3(3:1) or $3CaO$:Al_2O_3(3:1); (2) $5CaCO_3$:$3Al_2O_3$(5:3) or $5CaO$:$3Al_2O_3$ (5:3); (3) $CaCO_3$:Al_2O_3(1:1) or CaO:Al_2O_3(1:1); and (4) $3CaCO$:$5Al_2O_3$ (3:5) or $3CaO$:$5Al_2O_3$(3:5). These mixtures were heated, with or without calcium fluoride, in a tube furnace. The conditions of heating time, temperature, etc., were strictly regulated in each case. The amount of calcium fluoride in the raw mixtures was 1 per cent of the mixtures, and other percentages, 0.25, 0.50, 2:0, 3.0, 5.0, etc., were also compared in some cases. The heated products were tested systematically on the degree of combination between CaO and Al_2O_3 in the following sequence: (1) free lime or uncombined lime; (2) insoluble residue, or uncombined or free alumina; (3) total lime; (4) total alumina; (5) combined lime from (3)-(1) and its percentage; (6) combined silica from (4)-(2) and its percentage; (7) amount of synthesized calcium aluminates; (8) molecular ratio of combined lime to combined alumina, or molecular ratio of lime to alumina of the synthesized calcium aluminates; (9) amount of calcium fluoride remaining in the heated products, and its percentage.

Test Results

Some results are given in the tables, from which it is seen that the addition of 1 per cent calcium fluoride has a decided effect on the formation of calcium aluminates in the following points: (1) comparing the same degree of formation of calicum aluminates, the addition of 1 per cent calcium fluoride lowers the heating temperature by about 150 to 200 deg. C. (2) The combination of lime proceeds faster than that of alumina. The molecular ratio of lime to alumina becomes a little greater, and nearly 1.67 of the aluminate $5CaO$:$3Al_2O_3$ even at about 1,300 deg. C. The remaining calcium fluoride becomes gradually smaller at higher heating temperatures, showing easier vaporization than in the case of calcium silicates.

The combination test was carried out by changing the heating time from 0.5 hour to 1, 2 and 3 hours, with or without calcium fluoride, and the results in Table 2 were obtained. From these results it is seen that the combination between lime and alumina is considerably promoted by the presence of 1 per cent calcium fluoride, but longer heating is not so effective, even with the presence of calcium fluoride.

Further studies on the effect of different amounts of calcium fluoride (0.25, 0.5, 1.0 and 2.0 per cent) were carried out, and the results given in Table 3 were obtained. It is clear from

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Cement and Cement Manufacture, October, 1934.

Table 1—Comparison of Synthesis of Calcium Aluminate from Mixture $3CaCO_3$:Al_2O_3(3:1) with and without Calcium Fluoride (1 Per Cent). Heating Time, 1 Hour

		CaF_2				CaO			Al_2O_3				
No. of Exp.	Heating Conditions, Temperature Deg. C.	Added %	Theoretical Amount in heated product %	Remained %	Percentage %	Free %	Combined %	Percentage %	Free %	Combined %	Percentage %	Total amount of calcium aluminates %	Molecular ratio of CaO:Al_2O_3
CA_{3102}	1000	0	0	0	0	59.95	2.45	3.96	33.06	4.60	12.21	7.05	0.97:1.00
CA_{3104}	1200	0	0	0	0	46.70	15.54	24.98	16.20	21.54	57.10	37.08	1.31:1.00
CA_{3106}	1400	0	0	0	0	20.66	41.49	66.80	1.99	35.81	94.72	77.30	2.21:1.00
CAF_{31102}	1000	1	1.49	0.89	59.7	51.41	10.37	16.61	18.38	19.16	51.02	29.53	0.99:1.00
CAF_{31104}	1200	1	1.49	0.74	49.7	37.70	24.24	38.85	4.93	32.52	86.90	56.76	1.36:1.00
CAF_{31106}	1400	1	1.49	0.63	42.6	17.13	44.92	71.87	0.76	36.80	98.00	81.72	2.21:1.00

Table 2—Comparison of Synthesis of Calcium Aluminates from Mixture $3CaCO_3$:Al_2O_3(3:1) with or Without Calcium Fluoride (1 Per Cent) by Heating at 1,300 Deg. C. for 1 to 3 Hours

			CaF_2				CaO			Al_2O_3				
No. of Exp.	Temperature Deg. C.	Time hr.	Added %	Theoretical amount in heated product %	Remained %	Percentage %	Free %	Combined %	Percentage %	Free %	Combined %	Percentage %	Total amount of calcium aluminates %	Molecular ratio of CaO:Al_2O_3
CA_{3105}	1300	1	0	0	0	0	40.46	21.80	35.02	10.12	27.58	73.13	49.38	1.44:1.00
CA_{3111}	1300	2	0	0	0	0	36.41	25.92	41.60	5.57	32.07	85.20	57.99	1.47:1.00
CA_{3112}	1300	3	0	0	0	0	28.69	33.63	54.00	3.41	34.34	91.00	67.97	1.78:1.00
CAF_{31105}	1300	1	1	1.49	0.71	47.6	31.57	30.37	48.62	2.95	34.56	92.16	64.93	1.60:1.00
CAF_{31111}	1300	2	1	1.49	0.70	47.0	28.11	33.87	54.20	2.45	35.05	93.50	68.92	1.76:1.00
CAF_{31112}	1300	3	1	1.49	0.65	43.6	26.50	35.49	56.81	1.85	35.67	95.15	77.16	1.82:1.00

Table 3—Comparison of Synthesis of Calcium Aluminates from Mixture $3CaCO_3:Al_2O_3(3:1)$ with Different Amounts of Calcium Fluoride 0.5 to 2.0 Per Cent by Heating at 1,300 Deg. C. for 1 Hour

No. of Exp.	CaF_2 Added %	Theoretical amount in heated product %	Remained %	Percentage %	CaO Free %	Combined %	Percentage %	Al_2O_3 Free %	Combined %	Percentage %	Total amount of calcium aluminates %	Molecular ratio of $CaO:Al_2O_3$
$CAF_{[illegible]}$	0.5	0.75	0.42	56.0	32.08	30.03	48.55	2.16	32.40	94.30	65.43	1.56:1.00
$CAF_{[illegible]}$	1	1.49	0.71	47.6	31.57	30.37	48.62	2.95	34.56	92.16	64.93	1.60:1.00
$CAF_{[illegible]}$	2	2.99	0.78	26.1	30.91	31.35	49.90	2.01	35.13	94.59	66.48	1.63:1.00

Table 4—Comparative Results of Synthesis of Calcium Silicates from Mixture $3CaCO_3:SiO_2(3:1)$ with or without Calcium Fluoride (1 Per Cent)

No. of Exp.	Heating Temperature Deg. C.	CaF_2 Added %	Remained %	CaO Free %	Combined %	Percentage %	SiO_2 Free %	Combined %	Percentage %	Amount of calcium silicates %	Molecular ratio of $CaO:SiO_2$
CS_{3102}	1200	0	0	44.66	28.86	39.24	8.89	17.65	66.52	56.51	1.75:1.00
CS_{3104}	1400	0	0	30.81	43.10	58.26	3.91	22.49	85.21	65.59	2.05:1.00
CSF_{31102}	1200	1	1.15	33.12	40.16	54.18	4.43	21.14	82.75	61.32	2.00:1.00
CSF_{31104}	1400	1	1.17	8.18	65.07	87.65	2.07	23.21	89.62	88.28	2.99:1.00

Table 5—Comparison of Synthesis of Calcium Silicates from Mixture $3CaCO_3:SiO_2(3:1)$ with or without Calcium Fluoride (1 Per Cent) by Heating at 1,200 Deg. C. for 1 and 2 Hours

No. of Exp.	Heating Time Hr.	CaF_2 Added %	Remained %	CaO Free %	Combined %	Percentage %	SiO_2 Free %	Combined %	Percentage %	Amount of calcium silicates %	Molecular ratio of $CaO:SiO_2$
CS_{3102}	1	0	0	44.66	28.79	39.18	8.89	17.61	66.46	46.30	1.74:1.00
CS_{3106}	2	0	0	39.13	34.69	51.82	6.42	20.21	75.95	54.90	1.83:1.00
CSF_{31102}	1	1	1.15	33.12	40.16	54.18	4.43	21.14	82.70	61.30	2.00:1.00
CSF_{31106}	2	1	1.43	31.94	40.90	55.13	3.43	22.00	86.46	62.90	1.98:1.00

Table 6—Comparison of Synthesis of Calcium Silicates from Mixture $3CaCO_3:SiO_2(3:1)$ with Different Amounts of Calcium Fluoride (0.5 to 2.0 Per Cent) by Heating at 1,200 Deg. C. and for 1 Hour

No. of Exp.	CaF_2 Added %	Remained %	Percentage %	CaO Free %	Combined %	Percentage %	SiO_2 Free %	Combined %	Percentage %	Amount of calcium silicates %	Molecular ratio of $CaO:SiO_2$
CS_{3102}	0	0	0	44.66	28.79	39.18	8.89	17.61	66.46	46.30	1.74:1.00
CSF_{31102}	1.00	1.15	73.8	33.12	40.16	54.18	4.43	21.14	82.70	61.30	2.00:1.00
CSF_{31110}	2.00	2.10	67.7	28.35	44.54	59.95	2.75	23.56	89.55	70.85	2.02:1.00

these results that the more calcium fluoride added, the more the amount of vaporization increases. The amount of produced calcium aluminates and the molecular ratio of lime to alumina increase very slightly, owing to the amount of remaining effective calcium fluoride.

Further studies on the mixtures $5CaCO_3:3Al_2O_3(5:3)$, $CaCO_3:Al_2O_3(1:1)$, and $3CaCO_3:5Al_2O_3(3:5)$, with and without calcium fluoride or other fluorine compounds, are being carried on.

Calcium Silicates

A systematic study is reported on the effects of adding calcium fluoride on the thermal synthesis of tricalcium silicate, $3CaO.SiO_2$, from the mixture $3CaCO_3:SiO_2(3:1)$.

The mixture $3CaCO_3:SiO_2(3:1)$ or $3CaO:SiO_2(3:1)$ was heated with and without calcium fluoride. The heating time, temperature, analytical method of the products, etc., were strictly regulated. The amount of calcium fluoride mainly studied was 1 per cent of the mixture $3CaCO_3:SiO_2(3:1)$. Other percentages (0.25, 0.50, 2.0, 5.0 per cent, etc.) were also compared for their effects on the preparation of $3CaO.SiO_2$ by changing the heating time and the temperature.

The heated products were tested for the degree of combination between CaO and SiO_2 effected by the added calcium fluoride as follows: (*a*) free lime or uncombined lime; (*b*) insoluble residue or uncombined or free silica; (*c*) total lime; (*d*) combined silica or soluble silica; (*e*) combined lime from (*c*) — (*a*); (*f*) amount of synthesized calcium silicate from (*e*) + (*d*); (*g*) ratio of combined lime to combined silica from (*e*) — (*d*); (*h*) molecular ratio of combined lime to combined silica from 1.07 × (*g*) (*i*) amount of calcium fluoride retained in the heated products; (*j*) percentage of retained calcium fluoride to the theoretical amount of the fluoride added.

Some of the results are compared in Table 4. It can be seen that the addition of calcium fluoride (1 per cent) has a considerable effect on the combination of lime and silica to tricalcium silicate $3CaO.SiO_2$ even at 1,300 deg. C. According to the previous studies by S. Nagai and K. Akiyama and by K. Murakami, $3CaO.SiO_2$ could not be synthesized by heating only, even at 1,400 to 1,450 deg. C., from the mixture $3CaCO_3:SiO_3(3:1)$ without CaF_2. The addition of only 1 per cent of CaF_2 produces $3CaO.SiO_2$ very easily, even at 1,300 deg. C.

The time of heating was 1 hour in the above experiments. The comparison was carried on by changing the reacting time from 1 to 2 hours at 1,200 deg. C., with and without calcium fluoride (1 per cent). The results are shown in Table 5. The temperature of heating was 1,200 deg. C. in each case. These results show that the combination between lime and silica is not much promoted by longer heating, even with 1 per cent of calcium fluoride at 1,200 deg. C., so that the heating temperature

TABLE 7—COMPARISON OF DRY THERMAL AND HYDROTHERMAL SYNTHESES OF CALCIUM SILICATES FROM MIXTURES (a) $CaCO_3:SiO_2(1:1)$ AND $2CaCO_3\text{-}SiO_2(2:1)$ WITH OR WITHOUT CALCIUM FLUORIDE BY HEATING AT 1,100 DEG. C. OR 1,200 DEG. C. FOR 1 HOUR

No. of Exp.	Heating method	Heating temperature Deg. C.	Heating time hr.	CaF_2 Added %			CaO Free %			SiO_2 Free %			Amount of calcium silicates %	Molecular ratio of $CaO:SiO_2$
				Added %	Remained %	Percentage %	Free %	Combined %	Percentage %	Free %	Combined %	Percentage %		
CS_{1104}	Dry	1100	1	0	0	0	16.15	31.49	66.03	35.92	16.78	31.83	48.27	1.99:1.00
CSF_{11104}	Dry	1100	1	1	1.10	80.3	4.36	43.93	89.78	29.02	23.36	44.64	67.29	2.01:1.00
$CSFH_{1111}$	Wet	1100	1	1	0.89	64.9	0	48.99	98.72	28.46	21.99	43.56	70.98	2.38:1.00
CS_{2104}	Dry	1200	1	0	0	0	32.26	31.92	49.78	15.18	19.71	56.76	51.63	1.73:1.00
CSF_{21104}	Dry	1200	1	1	1.39	92.9	17.40	46.38	71.50	8.29	26.27	76.42	72.65	1.89:1.00
$CSFH_{2111}$	Wet	1200	1	1	0.56	53.3	16.46	48.63	73.26	7.60	26.68	78.10	75.31	1.95:1.00

must be higher than 1,250 to 1,300 deg. C. to obtain $3CaO.SiO_2$.

Higher Amounts of CaF_2

The experiments were further carried on, to study the effects of different amounts of calcium fluoride (1.00 to 2.00). The results are shown in Table 6. The heating temperature of 1,200 deg. C. is not sufficient to obtain $3CaO.SiO_2$ from the mixture $3CaCO_3:SiO_2(3:1)$, even with 1 to 2 per cent of calcium fluoride. The temperature must be higher than 1,250 deg. C., which is well in accord with the results given in Table 5. Comparative tests by heating at higher temperatures (1,250 to 1,300 deg. C.) will be carried out later.

In cement manufacturing practice it is commonly believed that the fluoride added to the raw mixture is volatilized by the burning, and the clinker does not contain any fluoride. The authors have ascertained that 70 to 80 per cent of the added fluoride is always retained in the products by heating, even at 1,300 deg. C. for 3 to 5 hours, but in the practical rotary kiln the burned gas contains much water and the temperature is a little higher than 1,400 deg. C. To study this point the authors compared the dry thermal synthesis with the wet thermal or so-called hydrothermal synthesis. The results are shown in Table 7. From these results it is seen that fluoride retained in the dry heated products was about 70 to 80 per cent, which is twice as large as that retained in the hydrothermally heated products.

Efficient Lubrication

(*Continued from page* 36)

and presses the lubricant into the inlet opening of the pump unit, which presses it against high resistance pressures by means of feed tubing to the lubricating points. The grease guide-plunger acts as the distributor for the grease, allowing it to pass first to one, and then to the other, of the two outlets of the pump unit. Various ratios between the drive shaft and the pump shaft can be provided, so as to meet different operating conditions.

Controlling Rate of Feed

The rate of feed is controlled, first, by the ratio between the drive shaft and the pump shaft; and second, by the adjustment of the individual pump unit.

In the actual business of lubricating, it is imperative that different lubricating points be given different quantities of grease or oil. This mechanism permits the independent adjustment of each pump unit, through alteration of the effective stroke of the plunger—an alteration that is accomplished by turning certain adjusting screws. A right turn of an adjusting screw decreases the quantity of lubricant delivered, while a left turn increases the quantity. A hand-crank serves the purpose of priming; or in case of necessity, the hand-pump may be used to increase the quantity of lubricant without in any way affecting the normal adjustment.

The entire pumping mechanism may be removed sidewise from the pump chamber after the pump head nuts are unscrewed.

Starting a Greasing System

When operation of a newly installed grease lubricator is started, it is necessary, of course, to fill the system with grease at once. This is done by adjusting all pump units to the full stroke—by turning adjusting screws to the left. The feed tubes are disconnected from the lubricating points and the lubricator outlets. The air-vent tap screw on top of the cast-iron housing is removed to allow the air to escape. The cylindrical tank is filled with grease, and the hand-crank is turned until the entire grease content is pressed into the pump chamber. The tank is then refilled until the grease issues in a steady flow from all the lubricator outlets, free from air bubbles. The feed tubes are then thoroughly cleaned, and are reconnected to the lubricator outlets. The feed tubes are then primed by means of the hand-crank, and when the grease reaches the end of the tubing the connection with the lubricating points is established.

Acknowledgment—Every cement mill operator knows and understands the imperative need for correct lubrication. It is to be hoped that non-operating executives may see the light, and that fewer plant superintendents will be compelled to operate with old-fashioned and wasteful lubricating methods. The systems here described and illustrated were developed and installed by the United American Bosch Corporation, of Springfield, Mass.

Clay-Gypsum Cement

(*Continued from page* 42)

(*d*) *Fineness.* The residue on a sieve of 900 meshes per sq. cm. (76 meshes per lin. in.) must not exceed 2 per cent, by weight.

Not less than 85 per cent, by weight, shall pass the sieve having 4,900 meshes per sq. cm. (178 meshes per lin. in.).

(*e*) *Tensile Strength.* The tensile strength of the cement when mixed with standard sand in the proportions of 1:3 (samples stored in air) must be not less than 130 lb. per sq. in. at the age of 7 days, and 200 lb. per sq. in. at the age of 28 days.

(*f*) *Compressive Strength.* Mortar samples with 1:3 proportions of cement and standard sand (stored in air) must have a compressive strength of not less than 1,000 lb. per sq. in. at the age of 7 days, and not less than 1,280 lb. per sq. in. at 28 days.

Determination of Magnesium

(Continued from page 38)

the standard sodium thiosulfate solution until the color of the iodine becomes faintly yellow. At this point add 2 ml. of the starch solution and titrate to the disappearance of the blue color.

3. *Calculation.*—The percentage of magnesia in a 0.5-g. sample may be calculated as follows:

Percentage of

$$MgO = [(B - C) \times A] \times 200$$

where A = the weight of MgO in grams per milliliter of standard sodium thiosulfate solution;

B = milliliters of standard sodium thiosulfate solution equivalent to 25 ml. of standard bromate solution, and

C = milliliters of sodium thiosulfate solution required in the titration.

Explanatory Notes

Note 9.—An excess of the 8-hydroxyquinoline reagent should be used. If it is small, the result of the determination of magnesia may be low; on the other hand, if large, the result may be high. The following guide may be used:

Approximate Content of Magnesia, Per Cent	Approximate Amount of Reagent Required, Ml.
0 to 1.5	10
1.5 to 3.0	15
3.0 to 4.5	20
4.5 to 6.0	25

Note 10.—The precipitate should be filtered within an hour. Prolonged standing may cause high result.

Note 11.—The amount of the standard bromate solution used may be as follows:

Approximate Content of Magnesia, Per Cent	Amount of Standard Bromate Solution, Ml.
0 to 1	10
1 to 2	15
2 to 3	20
3 to 4	25
4 to 5	30
5 to 6	35

Since the above methods were entirely new to many analysts, another cooperative investigation is under way, which is being participated in by 24 laboratories. The data so far obtained indicate great likelihood that a very satisfactory quick method may be obtained.

Cement Loading Terminal for River Craft

A. T. GRIFFITH, harbor master, writing in the Peoria (Illinois) *Transcript* of June 23, says that war department officials in Peoria have reports of plans being made by the Marquette Cement Manufacturing Co. at Oglesby for a new cement loading terminal. Their information is to the effect that the Marquette company has obtained a site at or near the mouth of the Vermillion river, two miles north and east of LaSalle. The plant at Oglesby is located near the Vermillion river.

The plan would include a pipe-line construction from the plant to the proposed terminal. Through this pipe-line the bulk cement would be pumped. It would go directly into the river carriers.

At the present time the Marquette company owns and operates a bulk cement terminal at Peru. The material is loaded at the plant in hopper cars and switched seven miles by rail to this terminal. There it is dumped into a pit beneath the tracks to be moved by conveyor to a pipe-line elevated above the railroad tracks. Through the pipe-line the bulk cement goes by compressed air and gravity into barges anchored alongside the adjacent river bank. Hundreds of tons of cement have been and are now being handled through this joint rail-river terminal. The new project would eliminate the rail line switch and add speed to the movement.

Owning one of the finest towboats and most modern bulk cement moving barge fleet on western rivers, the Marquette company was the first private carrier to use the new Illinois waterway. Their fleet made its initial Illinois river trip in March, 1931. At the present time river men report that it is operating on the Mississippi to and from the Cape Girardeau plant of the Marquette Cement Company. The cement moving via water from Peru recently to destination both north and south has been transported in barges of a common carrier.

Plans Silicosis Compensation

SENATOR POPE of Idaho is sponsoring a bill to be introduced in Congress providing for compensation for miners disabled by silicosis.

Compensation for miners totally disabled by the respiratory disease would be provided from a fund, 25 per cent of which would be supplied by the federal government, 25 per cent by the states and 50 per cent by the property for which the miner works.

Designed to meet the decision of the Supreme Court in the NRA case concerning the commerce clause of the Constitution, the planned legislation is based on the idea of having the mining states pass their own compulsory compensation laws to get the 25 per cent federal donation. Such state laws will require mines to take out insurance to cover the 50 per cent for which they will be responsible. Its sponsors hope that the preventive measures required in insured mines by the underwriters will help to prevent the disease.

Five Years' Production of Masonry Cement

PRODUCTION figures on natural, masonry and pozzolan cements, covering the 5-year period of 1929-1933, are reported in a 28-page pamphlet headed Cement, issued by the U. S. Bureau of Mines.

Natural, Masonry and Pozzolan Cements, Production and Shipments

Year	No. of active plants	Production, in bbl.	Shipments, in bbl.
1929	11	2,209,465	2,159,130
1930	11	1,792,083	1,787,016
1931	12	1,241,803	1,226,850
1932	15	456,785	524,844
1933	13	466,632	432,415

The 28-page pamphlet mentioned above contains also a number of statistical figures on portland cement, on foreign trade in cement, and on world production of cement. Copies may be obtained at 5 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

High Mortar Strength from Dolomite

THE May (1935) issue of *Cement and Cement Manufacture* mentions an article by L. Holleck, in *Tonindustrie Zeitung*, pages 1093-1095, 1934, in which the author declares that high strengths can be obtained with mortar made from dolomite-lime. When dolomite is burned at 850 deg. C. to a 20 per cent loss on ignition, the resulting product produces a mortar which is several times stronger than that obtained with ordinary lime. The type of dolomite-lime described has the approximate composition ($3MgO.2CaO.2CaCO_3$). If more CO_2 is driven off than that indicated by this formula the strength is reduced.

Men and Mills

[News of and for Cement Mill Men]

A clearing-house page for all kinds of news about cement men and cement mills. ℂ Readers in all mills, even though not regular contributors, are invited to send in news notes about personal and plant activities that may be of interest or value to the men in other mills.

The *Missouri Portland Cement Co.*, St. Louis, is retiring from the retail field and is placing on the market all the yards operated in the distribution of its products. Their disposal will not affect the company's manufacturing and wholesale business.

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Alpha Portland Cement Company, St. Louis, according to the Southern Illinois Reciprocal Trade Association, permitted its contract for natural gas to expire early in July to return to the use of coal in firing its product. The return of the plant to the burning of coal is the result of the Reciprocal Trade Association's efforts in inducing the state highway department to use only coal-fired cement for the construction of state highways.

The St. Louis plant will consume a minimum of 100,000 tons of coal annually. Inspection of the plant by officials of the association disclosed that the company has completed a modern coal drying plant and in the future will use pulverized coal as fuel.

●

The Glens Falls quarry, operated by the *Glens Falls Portland Cement Company*, Glens Falls, New York, won honorable mention in the National Safety contest of 1934 for operating without a lost-time accident.

●

The *Lehigh Portland Cement Company's* plant at Mitchell, Indiana, ceased operations on Monday, July 1, for an indefinite period.

The plant has been manufacturing cement during the past three months, and due to a decrease in orders, the warehouse is more than half full.

The plant usually operates about five months a year. It is reported the shut down will continue until early fall, although several men will receive employment during the summer.

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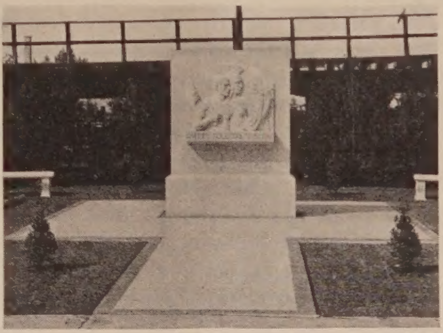

The safety trophy awarded the Buffington (Indiana) plant of the Universal-Atlas Cement Co., Chicago, dedicated on June 27.

The huge concrete monument is installed on a base of green terrazzo made with Atlas White portland cement, Verdolite marble chips and green pigment. Surrounding this terrazzo slab, which forms a 5-ft. wide walk entirely around the trophy, is a 4-in. black border of precast terrazzo. This border is made with Atlas Lumnite cement, Belgian black marble and black pigment.

A 5-ft. wide walk, 10 ft. long, leads from the plant driveway to the trophy base. This is also made of green terrazzo, with a 4-in. black border. Slightly to the rear and flanking the trophy are two white concrete benches. This setting, together with a special border of trees and shrubbery and a bed of flowers at each side, make a picturesque setting for the monument.

●

G. M. Block, formerly vice-president of *Missouri Portland Cement Co.*, was elected first vice-president and general counsel by the board of directors at its initial session following the annual stockholders' meeting, and *C. A. Homer*, formerly vice-president, was made second vice-president. *M. Moss Alexander*, president, and all other officers were re-elected. Stockholders elected *Jacob Weisheyer*, secretary, a member of the board, filling the vacancy. All other directors were re-elected.

The *Oregon Portland Cement Company* plant at Oswego, Ore., has reopened and is operating on a full schedule, employing 80 men at Oswego and 60 in the quarries. The plant had been shut down for some months.

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G. L. Kirp has been engaged by the *Petoskey Portland Cement Company*, Pestoskey, Mich., to head its chemical engineering activities and to prepare for the manufacture of at least three new brands of cement.

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H. C. Shields has been transferred from the Middle West to the New York office of the *Pennsylvania-Dixie Cement Corporation*, located at 60 East 42nd Street, where he is assistant manager of the service bureau.

●

The *Lone Star* cement plant at Bonner Springs, Kansas, has resumed operations.

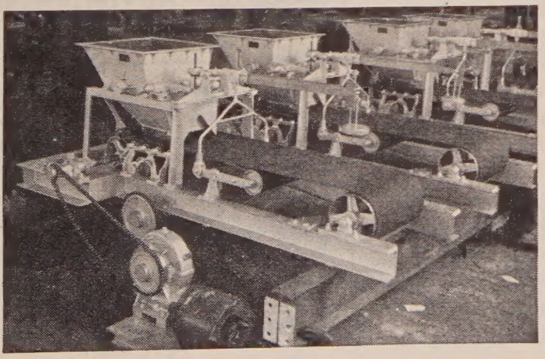
●

The board of directors of the *Northwestern States Portland Cement Co.*, Mason City, Iowa, held their semi-annual meeting in June with Col. Hanford MacNider, president, presiding.

Members of the board from out of town were: William Chamberlain, Chicago; William Stern, Chicago; Edwin White, St. Paul; Sumner T. McKnight, Minneapolis; M. T. Gunderson, Kenyon; S. L. Wright, Hollywood, and E. C. Pruden, Dubuque.

●

The LaSalle (Illinois) plant of the *Alpha Portland Cement Co.* has been awarded a safety trophy in recognition of its 1934 record. G. Lundberg is superintendent of the LaSalle plant.



Poidometers for Iola, Kansas, Plant of Lehigh Portland Cement Company

Schaffer Poidometers

are being used for weighing, proportioning and feeding clinker and gypsum into Hercules Mills and Compeb Mills.

They are being used also for weighing and feeding coal to dryers.

Consult our engineers with your problems.

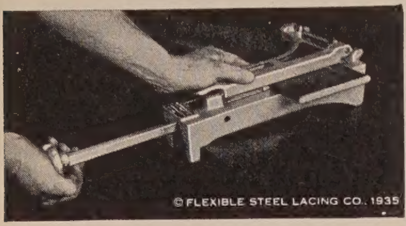
Send for Catalogue No. 5

SCHAFFER POIDOMETER CO.
2818 Smallman Street Pittsburgh, Pa.

MILL EQUIPMENT

ALLIGATOR Belt Cutter is an 8-inch flat belt cutting tool employing a new principle in mechanical belt cutting, just announced by the Flexible Steel Lacing Company, Chicago.

The cut is made by pushing the knife through the belt from one edge to the other. The knife is mounted on a plunger in a slot, and is operated easily by a direct arm push without mechanical leverage.



The Alligator belt cutter

The knife, of special alloy steel, will make several thousand cuts and is easily replaceable, they say.

The belt is held immovable by the equalizing clamp while the cut is being made. The clamp is also a guard for the blade. Clamp and frame are strongly built of aluminum alloy, the weight of the cutter being only 4 lb. and 3 oz.

•

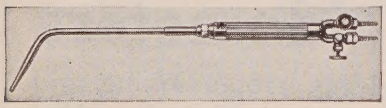
RICHARDSON'S multiple screw feed automatic scale is illustrated and described in Bulletin 8134 of the Richardson Scale Company, Clifton, N. J.

This scale is designed for bulk weighing or open mouth bagging, or both.

Accurate, clean and speedy automatic weighing is necessary in the cement industry and the weighing of pulverized, sluggish or lively, aerated and dusty materials constitutes a difficult problem.

•

PUROX No. 35 General Duty is a new welding torch just announced by The Linde Air Products Company, New York City. Constructed of extruded brass, Monel metal, and drawn copper, and with silver soldered tubes, this torch is rugged and can stand rough treatment. The tips are of hard-drawn copper.



Purox welding torch

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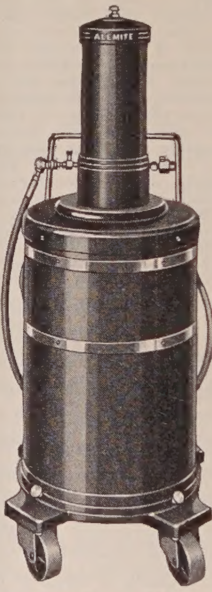
SELFVULC is a self, cold curing plastic and liquid rubber compound for corrosion and abrasion offered by the Self-Vulcanizing Rubber Co., Inc., Chicago.

Some specific uses are to restore and renew wearing surfaces of conveyor belts, floors, walks and runways; as an inside coating for chutes, flumes, hoppers, bins; and as lining for corrosion and abrasion protection for screw conveyors and troughs.

•

ALEMITE'S recently announced line of 1935 advanced lubrication equipment includes HP-100. This high pressure, air-operated barrel pump converts any original 100-lb. lubricant container into an efficient powergun for industrial and truck lubrication. Utilizing a nitralloy piston, a low pressure pump carries a continuous flow of lubricant from the container to a high pressure pump. From there the lubricant is delivered at the rate of 18 ounces of regular lubricant per minute, or 6½ ounces of the extremely fibrous and heavy lubricants. A pressure, 33 times the air pressure used, is available to furnish a delivery sufficient to take care of several outlets at once.



Alemite high-pressure barrel pump

The direct flow of lubricant from container to pump without exposure not only prevents any contamination of the grease, but insures strict cleanliness for the most particular plant. Using the Alemite barrel pump an entire plant lubrication job can be completed, quickly without a single drop of lubricant dripping onto the floor or machinery.

Removal of the barrel pump's top cover, held in place with one bolt, gives access to all the working parts of the double action air motor. The check valve may be cleaned without detaching the hose from the gun.

This maroon, chrome plated barrel pump is provided with either a three or four-wheeled truck for portability or a base for stationary installation.

Industrial Literature

WILLIAMSPORT Wire Rope Co., Chicago, announces a new catalog showing all the latest constructions of wire rope.

With the folder announcing this new catalog, is a business reply card ruled for a notation of expected wire rope requirements and offering a stainless steel engineers rule to those supplying such requirements.

•

CATALOG No. 1515 published by Link-Belt Company, Philadelphia, Chicago, San Francisco, is devoted to its newly developed line of motorized speed reducers, in which the motor is mounted directly on the side of the reducer housing, thus making a shaft coupling or a motor base plate unnecessary.

It shows by means of an example how the proper reducer can be selectd from the tables, which give dimensions, capacity ratings, and speed ratios.

Manufacturers' News

THE A. P. Green Fire Brick Company of Mexico, Mo., has celebrated its Silver Anniversary, and is distributing a Silver Anniversary booklet telling the story of A. P. Green progress over the past quarter century. A. P. Green is the founder and active head.

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P. J. Potter, former 2nd vice president, was elected a director and vice president of the Pangborn Corporation, Hagerstown, Md., according to a bulletin issued July 1st by Thomas W. Pangborn, president and general manager.

CLASSIFIED ADVERTISEMENTS

USED EQUIPMENT

MUST MOVE

5—No. 80 Bailey Feeders

2—Smidth Tube Mills.
1—AC Gates 4K Gyr. Crusher 8x30.
2—Penn. S-7 Hammer Crushers 36x16.
1—AC McCully Crusher 10x52.
1—Goodman No. 48 U/G Electric Shovel.
12—20 & 30 yd. Dump Cars.
1—25 Ton Loco. Crane 50' & 75' Boom.
1—30 Ton Loco. Crane 60' Boom.

ALL TYPES BUCKETS, CRUSHERS, MOTORS & EQUIPMENT

Iron & Steel Products, Inc.
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